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THE PLACE OF THE TROLLEY.

Once more the annual meetings of the three national street railway bodies have come around, and there is every indication that the conventions in St. Louis will be successful. Owing to the fact that the Exposition offers so many attractions, and the Transportation Building so many lessons, the usual elaborate provision as to programme and exhibits has not been necessary, and, indeed, it is not wise to force too much work into a convention week at a World's Fair. Either the work or the Fair has to be neglected.

The street railway industry looks back on another year of progress and prosperity. The art has seen some notable advances, and its resources are larger to-day than ever, while there is not a local system in the country which has not been improved or extended in some respect. For ourselves we cannot discover any item of serious import making against the permanence of the street car as an element in urban civilization, as well as a necessity throughout large regions heretofore unsupplied with facilities for travel; but we have been interested to note that in one or two quarters predictions have been made as to the speedy "passing" of the car. In fact, it might even be said that there had been a crusade against the street car and the street car track, associated with an agitation in favor of the self-contained automobile. It is not a new idea that the automobile might prove a formidable rival for the street car, but the suggestion is a rather radical one that the car "must go," and that the automobile should reign supreme and alone.

We observe an interesting interview with Mr. Charles A. Lieb on this subject in which he says: "Unquestionably, with the inventions that have already been proven out and demonstrated as practicable, the automobile system is to-day, wherever the pavement is modern, in a position to compete car for car with any known traction system, alike on the score of systematic operation, economy and maintenance of schedule." Mr. Lieb as a veteran in both the street railway and the automobile fields, has a right to his opinions, and the mere fact that such views are held is in itself impressive. There is a big "if" in the stipulation that the paving should be good. A recent trip around New York inspecting lights convinced us that the road pavement was about as bad as the illumination was good, and that any automobilist made the trip at the risk of his machine and his life. However, paving can be improved, and when it is perfect, automobiling over it is an exquisite pleasure. It seems to us that after all the street railway managers are the people to try out this problem, for the transportation business is theirs anyhow, and we have been interested to observe that some of them are taking up the question of automobile feeder routes. Meantime we hardly think the great mass of the population is ready to go back to omnibuses, even without the horses. Another point is that as Mr. Lieb himself indicates what is needed quite as much as anything else is a limitation of the manner in which merchandise is handled along the great arterial thoroughfares. As things are to-day, the street cars do not get a fair show, but are blocked all the time by freight, and their passengers thus also suffer inordinate loss of time. Now, if the freighting vehicles were compelled to be automobiles, there would at once be an enormous gain in time and in street space, and the tracks would then be susceptible of a more rational consideration than that involved in merely abolishing every one of them.

One radical point suggested by Mr. Lieb is that only by the adoption of automobiles can fares ever be reduced to three cents in New York. In other words, the cost of construction, operation and renewal of the street car system justifies and necessitates the five-cent fare. On the other hand, if, as he claims, in a few years autobusses can carry passengers for two cents the car mile, they will certainly make a place for themselves. We suggest that along with other topics these offer an interesting study for all transportation managers who believe we have not yet reached finality in the art.

Discussions of the International Electrical Congress.

As pointed out on page 621 of this issue, all members of the International Electrical Congress of St. Louis are cordially invited to contribute written discussions of any of the papers presented. Nearly one hundred of these papers were distributed at the St. Louis meetings in printed form as advance copies subject to correction by their authors. It was naturally impossible for all the members to be present at the Congress. Moreover, even when members were present it was often impossible for them to attend the reading of all the papers in which they took interest. In view of these facts and in order to secure as full a discussion as possible of the papers presented, all members have been invited to supplement the discussion in writing, provided that such adjourned communications shall be sent in to the general secretary without delay. It is evident that delay in delivering such discussion would retard the printing of the *Transactions*, and it is important that the *Transactions* should be printed and distributed among the members as soon as possible in order to avoid loss of interest by the lapse of time. Theories and practices change so rapidly in electricity and its applications that papers on these subjects are most acceptable when, like cakes, they are served hot.

The New York Rapid Transit System.

The completion of the splendid metropolitan rapid transit system is far more than the close of a brilliant achievement in modern engineering; it is a triumph of civic necessity over all the Powers of Darkness that beset from within and without the uplifting of a great city to its destiny. Land and sea with ledges and quicksand ooze were open and formidable enemies, but at their backs were gathered an evil phalanx of intrigues and blunders and failures, of private and public heedlessness and mismanagement, handed down from generations dead. Few realized half a century ago the destiny of New York and fewer still gave any thought to posterity save as they might squander its birthright. And so the city grew as best it might, with streets built and underbuilt and crowded with surface cut and filled and graded, huge and populous and unkempt without ideals physical or moral, for year after year. Civic aspirations and foresight have been slow of growth, but in our own time they have taken form and drawn men under their spell, so that out of chaos order is evolved, and slowly and with tremendous effort the metropolis is coming into its own. Meanwhile a mighty twelve-story city has grown up with such a tide of humanity surging up and down and back and forth as has never before been seen in the world's history.

The struggles to evade and to compass the inevitable would fill a volume. The projects for viaducts and double-decked overhead structures and tunnels might well deserve the name of legion. For more than a quarter of a century an iron grating on the edge of City Hall Park bore mute witness to the first premonition of the struggle for rapid transit. Few among the thousands who walked over it daily realized that beneath it were the remains of a pneumatic tube, laid when the Tweed Ring was at the height of its iridescent career, and intended to solve the problem that had hardly then been stated. The present enterprise arose from bitter necessity and has been pushed to a successful conclusion by the same overwhelming force. It is on a scale commensurate with the public needs at least for the present, and it has upon the whole been carried out wisely and well. Of the various plans proposed, the one chosen of a wide tunnel near the surface was the most practical, although it involved enormous local difficulties. The deep tunnel which won many friends on account of its success in London and its apparent freedom from minor engineering faults, involved major faults that hopelessly condemned it under existing conditions. Aside from construction troubles, it is a grave question whether such a tunnel with the huge elevator capacity demanded could have been made to do the prodigious work that must be done. Even with the considerable use of escalators, which is a feature of the present subway, means of access to an underground line are none too good. The Paris tunnels are more practicable and more in line with requirements here, but they have a task of far less magnitude, and we have had the opportunity of profiting by their mistakes, which have proved to be somewhat numerous. No American city has developed precedents of much value. The Boston subway, highly successful within its limitations, involved no such maze of structural complications as beset the engineers of the metropolitan enterprise, and it was overcrowded, while yet it was hardly completed. It is a most difficult task to gauge the traffic possibilities of a city, and right here the projectors of the Boston subway fell down. It is hard on such a rapid transit system as that of New York to give adequate access to stations or sufficient platform room. The provisions for the latter, based as they are upon the use of long trains, certainly look adequate for the immediate future. The former is not so easy to estimate, but remedies can be applied with comparative ease if necessary. The route is certainly well chosen. Especially has it displayed keen judgment of the necessity of subdividing traffic. An immensely long city like New York demands such a distribution of lines as will avoid the tendency to concentrate a traffic already at every point congested to the verge of impossibility. The subway will relieve the situation in parts of the city that sorely needed it without, we think, tending to produce new points of congestion. The only danger point in this respect seems to be the Grand Central Station.

The equipment of the system leaves little to be desired. Fortunately, in the years of preparation for rapid transit, electric traction has been brought to a point where it is fully adequate to meet the demands that will be imposed upon it. The key to the situation was the use of the multiple-unit system with its immense power of acceleration, which probably increases the effective working capacity of the subway by at least a quarter, and perhaps much more. By its use it was possible to employ trains of a length that would be utterly impracticable without it, and one eight-car train is far more than the equivalent of two four-car trains, since it can be run on almost the same headway. Of almost equal importance was the working out of a proper block signal system, for which in this case one track rail has been systematically reserved, a clever device that ought to solve all the outstanding problems of block signaling on electric lines. The distribution of current by a third rail almost went without saying, but in this instance two features of the electric rail are noteworthy. First, it is made deliberately of extra high conductivity, fully twenty per cent. higher than the ordinary modern track rail. Second, it is adequately protected as regards accidental contacts. At the present time the use of an unprotected third rail often amounts almost to criminal negligence, but in this instance not only is the protection thorough, but the whole arrangement of the contact rail

seems very business-like and practical. The electrical distribution from and to the sub-stations involves a good many novel features, of which the most worthy of comment is the primary distribution at 11,000 volts. Much of the earlier distribution to rotaries was rather half-hearted in the matter of voltage, and we are glad to see a move onward in the right direction.

The generating station is now fully described and it certainly stands as a splendid example of modern central station building. For these immense outputs the cellular plan is surely the only one to follow in concentrating the whole plant under a single roof. It is an exemplification of the revised proverb credited to Carnegie, "Put all your eggs in one basket, and then watch that basket!" Space forbids discussion of the many interesting details of the station equipment. The most discussed feature of the general design is the use of reciprocating engines instead of the turbines used in several recent large plants. It was, however, a choice erring, if at all, in the direction of sound conservatism. The engine economy guaranteed is 12.25 pounds of dry steam with 175 pounds steam pressure and 26 inches vacuum, at full load. One is tempted to wonder at the probable effect of superheating with an initial condition like this. The most interesting feature of the physical equipment is to be found in the unusual precautions taken in the car construction. The cars are framed and braced almost like Pullmans, with platforms designed to avert telescoping, and with braking capacity to remove the chance of it. The cars are made as nearly fire-proof as a wooden car can be made, reinforced with asbestos and steel plates, and a large number of steel cars, impossible at first to obtain, are now under construction. So far as human intelligence can foresee, danger from collision and fire is at a minimum here. The whole system is a memorable achievement and reflects great credit upon the engineers who put it through, and no less upon the public-spirited and far-sighted men who made it possible and drove it forward, regardless of obstacles, to successful completion.

CONDENSATION NUCLEI.

In a very general way, the popular understanding of the nature and production of rain is unusually rational and precise. Rivers feed the oceans. The sun evaporates fresh water vapor from the salt seas. The warm, invisible vapor, carried far and high, chills into cloud and fog on reaching colder climes. Finally, cloud precipitates, by a yet greater chill, into the gentle rain from heaven that falls upon the earth beneath. But although this theory is clear enough for rough practical purposes, yet, when it comes to accurate detail, every stage of this vast and wondrous process of distillation is beset with difficulty of comprehension, so limited is our understanding of the simplest events in nature. Thus, confining attention to the phenomenon of condensation, it is hard to understand how drops are formed from water vapor. What is it that starts a drop? What forces foster or retard its growth? Why are fog droplets produced under some conditions and raindrops built up under other conditions? Many such questions must yet remain unanswered. Nevertheless, the subject possesses, perhaps, great practical importance for humanity. It is quite conceivable that some day rain may be under some degree of control. For example, it is conceivable that rainfall in any locality might, with apologies to the umbrella trust, be stimulated at night and retarded during daylight hours. But whatever the future may have in store in the way of a rain bureau or of rain engineering, it is clear that no great progress toward rain control can be made until the phenomena of condensation and precipitation have been thoroughly explored and explained. A paper by Prof. C. T. R. Wilson on "Condensation Nuclei," presented before the recent International Electrical Congress, discusses in a very interesting way some of the phenomena of condensation. The author has developed an apparatus which is called a cloud chamber, and which permits of suddenly rarefying, in adjustable ratio, a known volume of moisture-laden air, for the purpose of studying the cloud thereby produced. From the amount of the expansion the extent of the sudden chill is known, and knowing the temperature and vapor pressure of the water in the chamber before the chill takes place, the degree of supersaturation at which the miniature cloud forms is readily determinable.

It was shown long ago by Lord Kelvin, who has spent many years in showing new things to numerous departments of science, that a small drop of pure water suspended in pure air must evaporate in air that is saturated with water vapor from the standpoint of a flat surface of water. That is to say, when there is so much water vapor in air that pure water in a lake or a saucer will no longer evaporate into it, the air is said to be saturated with water vapor for the particular existing conditions of pressure and temperature. Nevertheless, into such saturated air water from a little spherical drop will evaporate. Consequently, air which is saturated to a flat surface of water is unsaturated to the spherical surface of water on a small drop, owing to the action of the surface tension on the curved surface. In general, air must be many times supersaturated with moisture before a small drop will be able even to hold its own, much less to grow. If, however, a little drop of water receives an electric charge, or, if it holds a substance in solution, such as common salt, then it may become stable and a smaller degree of supersaturation will enable it to grow. Electric ions in dust-free air are pointed out as serving as nuclei upon which pure water drops may grow, when the supersaturation of moisture is about four-fold. Fog droplets, i. e., a more numerous aggregation of relatively smaller drops, are formed when the supersaturation is eight-fold. An electric field is capable of clearing fog-laden air, because it develops a moving force toward all the electric charge nuclei on which the fog droplets are built.

It would seem, therefore, that neither clouds nor fog can form in moisture-laden air in the absence of nuclei. There must be something on which to make a start in the process of building up a water drop. The nuclei are usually electric ions, but exceptions are found in certain cases, the nature of which is not clear. Thus, air which has been passed over phosphorus, a substance that slowly oxydizes on exposure to the atmosphere, is found to possess the property of forming clouds with but little supersaturation of moisture, and an electric field has but little influence upon such drops. Ultra-violet light, also, passing through air, seems to have the property of producing therein ions that are loaded in some way. These ions will not readily disperse under the action of an electric field, nor do they require much supersaturation for the building of water particles. The paper concludes by pointing out that there are thus three principal classes of nuclei on which water can condense in air. The first are ordinary ions such as are produced spontaneously or by Röntgen rays, which move with a velocity exceeding 1 cm. per second in a field of one volt per centimeter and require a four-fold or six-fold saturation for drops to form on them. The second class are loaded ions which move with less than one-thousandth part of the velocity of first-class ions in a given electric field, and which require little or no supersaturation of moisture to build up drops. The third class are uncharged nuclei, also capable of building without sensible supersaturation. It is evident that only a first-class fog could be dispelled by electric machines. Second-class fogs would be very slow to dissipate, and third-class fogs might not dissipate at all under electric action. It would be interesting, although of doubtful practical importance, to know what percentage of London fogs are first-class.

Programme of the St. Louis Street Railway Conventions.

As already announced, the various street railway associations will hold their annual conventions in St. Louis next week. The meeting of the American Railway Mechanical and Electrical Association will be held on the second floor of the Transportation Building, World's Fair Grounds, on October 10, 11 and 14. The meeting for the first day is called at 10 a.m. The opening address will be delivered by John I. Beggs, vice-president and general manager of the Milwaukee Electric Railway & Light Company. In addition, the "Question Box" will be discussed and papers will be presented on "Maintenance and Inspection of Electrical Equipment," by John Lindall, of Boston; "Wheel Matters," by J. Millar, of Buffalo; "The Ideal Shop," by W. D. Wright, of Providence, and "Universal Car Body," by W. W. Annable, of Grand Rapids. The meeting on October 14 will be a joint meeting with the Accountants' Association to discuss "Shop Records and Accounts." The report on this subject has been prepared by H. H. Adams, of Baltimore, and H. E. Farrington, of Boston, for the Mechanics, and H. M. Pease and W. G. McDole for the Accountants. This meeting will convene at 9.30 a.m. The headquarters of the American Railway Mechanical and Electrical Association will be at the Inside Inn.

The convention of the American Street Railway Association will also be held on the second floor of the Transportation Building, and will be called to order at 10 a.m. on October 12 and 13. On Wednesday the body will be addressed by Hon. D. R. Francis, Hon. Rolla Wells, Mayor of St. Louis, and Prof. W. E. Goldsborough. In addition papers will be presented on "Steam Turbines," "Reciprocating Engines," "Gas Engines," "Transfers" and "Signals." The annual banquet has been abandoned, owing to the difficulty of finding any place where a caterer could take care of such a large number of people as always attend the affair. The headquarters of the association will be at the Southern Hotel. The registration office will be open all day Monday and Tuesday and on Wednesday morning.

The first meeting of the Accountants' Association will be held at 3 p.m. October 13, in the parlor of the Inside Inn, at which the annual address of the president will be given and a report will be rendered by E. M. White, of Hartford, on "A New Collection of Blanks and Forms." The meetings on October 14 and 15 will be on the second floor of the Transportation Building. That on October 14 will be devoted to the joint report of the A. R. M. and E. A., mentioned above. On October 15 the meeting will convene at 9.30 a.m. and a report will be received from C. N. Duffy, of Chicago, on the "Standard System of Accounting." The "Question Box" will also be discussed.

Electrical Exhibition in New York.

As already announced in these pages, an electrical exposition is to be held at Madison Square Garden, New York City, December 19 to 28, inclusive. This exposition is to be held under the patronage of the Electrical Contractors' Association, of New York City, a member of the Building Trades Employers' Association. The association has appointed a committee to act in conjunction with the exposition management, the chairman of the Contractors' Association being James R. Strong. Acting with him are J. P. Hall, S. Davis, L. K. Comstock, J. C. Hatzel and George William Russell, Jr. The management of the exposition itself is in the hands of Mr. L. Lawrence Weber and Ed. F. Rush, whose offices are in the Knickerbocker Theatre Building, Broadway.

It is the aim of the management to leave nothing undone that will insure success and the interest of the contractors in the affair should lead to a large number of exhibits being made. It is expected that many of the foreign exhibitors at the St. Louis World's Fair will embrace this opportunity of displaying their apparatus and equipment to native manufacturers and students of electrical machinery, before they return to their homes abroad. Madison Square Garden is equipped with a large electrical plant of its own and current will be furnished to the exhibitors at a minimum rate.

It is particularly desired by the management to show all machinery and apparatus in actual operation. The decorations and the amusement features are in the hands of a special committee, who are experts in this line. The interior illumination will be a feature. The entire arena floor space will be given over to exhibition purposes.

Roentgen Rays in Surgery.

A dispatch from Berlin, Germany, of September 20 says:

"In to-day's sitting of the Dermatological Congress in Berlin, the subject of the treatment of cancer was discussed with much animation. Prof. von Petersen spoke on the subject of non-surgical treatment of epithelioma, and came to the following conclusions: (1) That epithelioma is curable without operation only in its initial stage; (2) that the best results are obtainable by "Finsenlicht," inasmuch as this treatment has no deleterious effects. Unfortunately, it is very expensive; (3) that Röntgen rays are often productive of good results, but they must be employed with great caution; (4) radium rays give positive results, but are accompanied by dangers still greater than those arising from the use of Röntgen rays; (5) small surface epithelioma can be healed by continued bandaging with a solution of from 5 to 15 per cent. of soda.

Prof. von Bergmann then spoke. He maintained that every kind of epithelioma can be permanently healed by means of surgery, whereas only a portion of the cases are healed by treatment by light. He admitted that when severe complications already existed the surgeon could not cure the patient. But in those cases the Röntgen rays also failed. Hitherto, he said, no cancer which has proved impossible to operate for had been healed by the Röntgen rays. It was true that in perfectly hopeless cases the pain of the patients could be alleviated by Röntgen and radium rays, but this simply meant the prolongation of the life of the patient, and not his cure.

Dr. Leredde, of Paris, who followed, explained that a clever doctor could always avoid causing harmful effects when using radium in cases of cancer. He had, he said, registered good results from the use of radium. The president, in addressing the meeting, pointed out that a careful distinction must be drawn between the different kinds of epithelioma. Deep-rooted cancer, he thought, ought to be operated upon immediately if an operation were possible, but superficial epithelioma should be treated by Röntgen rays. The results of the sitting seem, then, to be as sketched by the president. It was admitted that the cause of cancer is still unknown.

Sir William Ramsay on the Salaries of Science.

Before sailing this week for England after a six weeks' stay in this country, Sir William Ramsay, K.C.B., F.R.S., Professor in Chemistry at the University College, London, was entertained by the Physical Science Departments of the Brooklyn Institute of Arts and Sciences at a farewell reception and banquet given in his honor at the Union League Club in that borough. Sir William, in responding to the last toast of the evening, said that during his stay in this country he had been greatly impressed by the high power of organization displayed by leading manufacturers and commercial men, but had also learned that men employed in a scientific capacity —especially those engaged in teaching the sciences as well as law and medicine—were earning less than they would earn if they were engaged in industrial pursuits.

"This condition of affairs," said Sir William, "unless remedied, and remedied soon, before long will lead to the lowering of the whole educational status, for it will inevitably react upon the training of professional and scientific men in this country. If trained by third-rate teachers—as they must be—it is unlikely that they will take the rank which they would have taken if their teachers had been men of first-rate ability.

"It is not necessary that every professor should earn high emoluments, but it is necessary that those who fill the most important positions in the leading universities of the country should be well paid. I have noticed that very large sums are left or given to teaching institutions in America by a number of rich men. Generally these sums seem to be applied to the erection of new buildings and sometimes to the founding of entirely new institutions. While the spirit which leads to such beneficent gifts should meet with the commendation of all men, I would suggest that it would be better if prospective donors would increase the emoluments of existing chairs, and, if they wish to perpetuate their names in connection with such gifts, these chairs could easily be named after them—for example, the Smith Chair of Medicine, the Brown Chair of Jurisprudence, and so on."

The recent remarks by Sir William, quoted by us, as to the indifference of American manufacturers to scientific knowledge and literature, have been widely commented on.

Underground Rapid Transit in New York City.—I.

FIG. 1.—CITY HALL STATION.

NEARLY five years have run their course since the Mayor of New York City broke ground for the new underground road which provides for Manhattan Island and adjacent districts a comprehensive system of sub-service transportation. Now within a week or two the system will be available to the public. In the meantime the city has been subjected to the unavoidable inconveniences attendant upon such a huge enterprise, and begins to realize that, after all, it was worth while to be disemboweled and eviscerated in order to secure this splendid addition to its facilities for travel. Although it enjoys an excellent electric street railway system in the service of the New York City Railway Company, and although under the electric regime the Manhattan Elevated has displayed a marvelous ability to increase its traffic, the fact remains that the "subway" was badly needed. In fact, Mr. W. B. Parsons, chief engineer of the city subway board, has been credited with the remark that the growth in population of the city called for a new service of this kind well nigh every four years. This is equivalent to saying that the possible patronage of New York's transportation facilities outruns their extension constantly, a corollary to which would be an acknowledgment of the truth that such extensions must prove a good investment. No one now doubts that the New York subway, as operated by the Interborough Rapid Transit Company will pay, but there was a long record of inconclusive and ineffective effort before Mr. August Belmont and his associates crystallized into organic shape and onward movement the plans now carried out to definite reality.

In the spring of 1902 the Interborough Rapid Transit Company, the operating railroad corporation, was formed by the interests represented by Mr. Belmont, he becoming president and active executive head of this company also, and soon thereafter Mr. John B. McDonald, the contractor, assigned to it the lease or operating part of his contract with the city, that company thereby becoming directly responsible to the city for the equipment and operation of the road. In the summer of the same year, the Board of Rapid Transit Railroad Commissioners having adopted a route and plans for an extension of the subway under the East River to the Borough of Brooklyn, the Rapid Transit Subway Construction Company entered into a contract with the city, similar in form to Mr. McDonald's contract, to build, equip and operate the extension. In January, 1903, the Interborough Rapid Transit Company acquired the elevated railway system by lease for 999 years from the Manhattan Railway Company, thus assuring harmonious operation of the elevated roads and the subway system, including the Brooklyn extension. The incorporators of the Interborough Rapid Transit Company were William H. Baldwin, Jr., Charles T. Barney, August Belmont, E. P. Bryan, Andrew Freedman, James Jourdan, Gardiner M. Lane, John B. McDonald, DeLancey Nicoll, Walter G. Oakman, John Peirce, William A. Read, Cornelius Vanderbilt, George W. Wickersham and George W. Young. The incorporators of the Rapid Transit Subway Construction Company were Charles T. Barney, August Belmont, John B. McDonald, Walter G. Oakman and William A. Read.

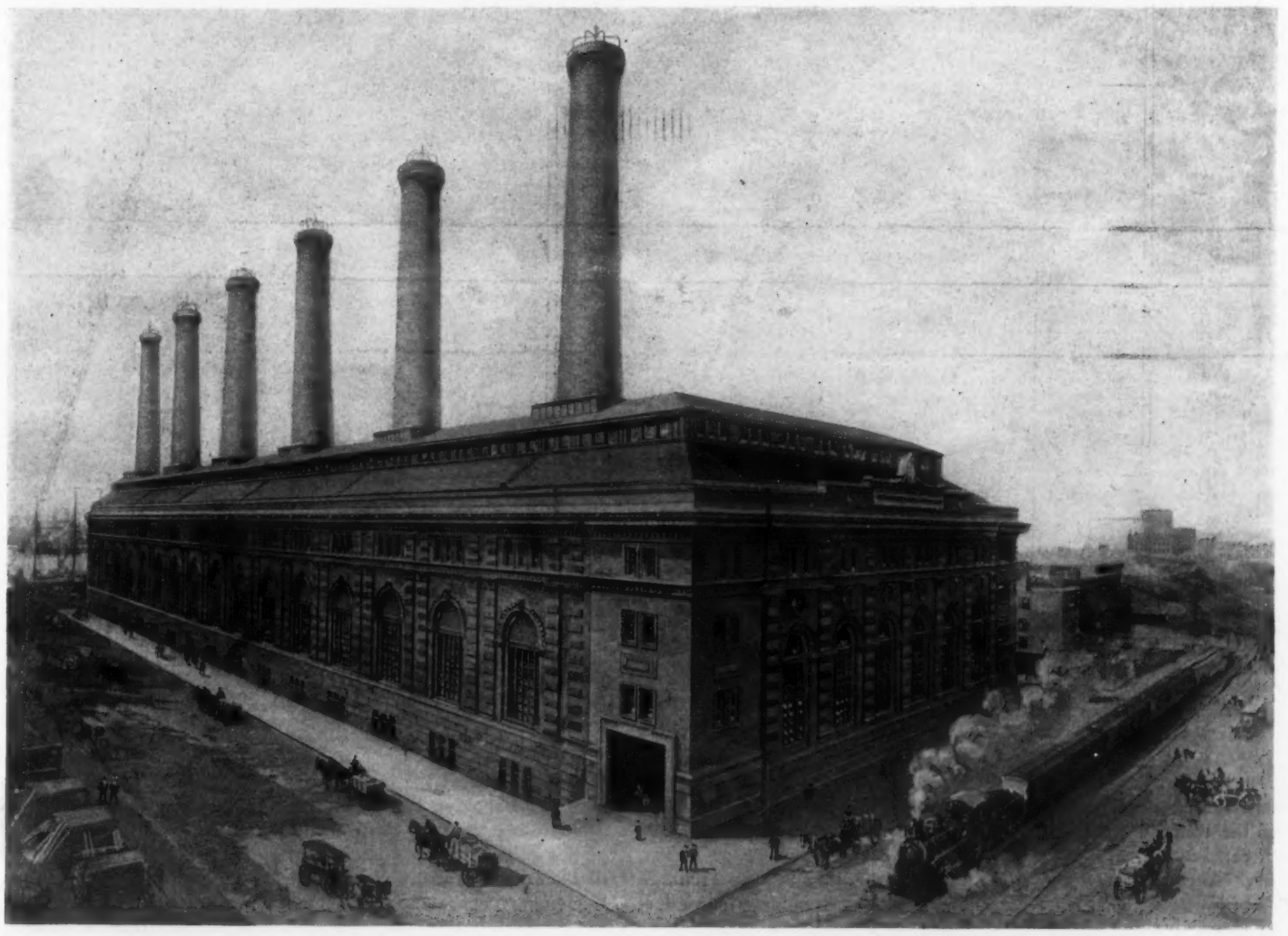


FIG. 2.—GENERAL VIEW OF POWER HOUSE OF THE INTERBOROUGH RAPID TRANSIT COMPANY.

The city as the actual owner of the subway was authorized in 1900 to issue bonds not in excess of $50,000,000 at 3½ per cent. and $5,000,000 for property rights, and to enter into a contract for the private construction and operation of the system, the term of con-

tract being fifty years on a rental equal to the interest on the bonds and 1 per cent. additional. The contract with Mr. McDonald referred to above, was for $35,000,000, and not in excess of $2,750,000 for terminals, station sites and other purposes. It is needless to say that it took courage of a high order to raise the money required, face the difficulties and bring matters to the point where the citizen of New York for his five cents could command the benefits of the great system now entering upon operation.

THE ROUTE.

The Rapid Transit Commission proposed, in 1897, the so-called "Elm Street route," the plan finally adopted, which reached from the territory near the General Postoffice, the City Hall, and Brooklyn Bridge Terminal to Kingsbridge and the station of the New York and Putnam Railroad on the upper west side, and to Bronx Park on the upper east side of the city, touching the Grand Central Depot at Forty-second Street. Subsequently, by the adoption of the Brooklyn Extension, the line was extended down Broadway to the southern extremity of Manhattan Island, thence under the East River to Brooklyn. The routes in detail are as follows: Beginning near the intersection of Broadway and Park Row, one of the routes of the railroad extends under Park Row, Center Street, New Elm Street, Lafayette Place, Fourth Avenue (beginning at Astor Place), Park Avenue, Forty-second Street and Broadway to One Hundred and Twenty-fifth Street, where it passes over Broadway by viaduct to One Hundred and Thirty-third Street, thence under Broadway again to and under Eleventh Avenue to Fort George, where it comes to the surface again at Dyckman Street and continues by viaduct over Naegle Avenue, Amsterdam Avenue and Broadway to Bailey Avenue, at the Kingsbridge station of the New York & Putnam Railroad, crossing the Harlem Ship Canal on a double-deck drawbridge. The length of this route is 13.50 miles, of which about 1½ miles are on viaduct.

Another route begins at Broadway near One Hundred and Third Street and extends under One Hundred and Fourth Street and the upper part of Central Park to and under Lenox Avenue to One Hundred and Forty-second Street, thence curving to the east to and under the Harlem River at about One Hundred and Forty-fifth Street, thence from the river to and under East One Hundred and Forty-ninth Street to a point near Third Avenue, thence by viaduct beginning at Brook Avenue over Westchester Avenue, the Southern Boulevard and the Boston Road to Bronx Park. The length of this route is about 6.97 miles, of which about 3 miles are on viaduct.

At the City (Borough) Hall there is a loop under the Park. From One Hundred and Forty-second Street there is a spur north under Lenox Avenue to One Hundred and Forty-seventh Street. There is a spur at Westchester and Third Avenues connecting by viaduct the Manhattan Elevated Railway Division of the Interborough Rapid Transit Company with the viaduct of the subway at or near St. Ann's Avenue.

The route of the Brooklyn Extension connects near Broadway and Park Row with the Manhattan Bronx Route and extends under Broadway, Bowling Green, State Street, Battery Park, Whitehall Street and South Street to and under the East River to Brooklyn at the foot of Joralemon Street, thence under Joralemon Street, Fulton Street and Flatbush Avenue to Atlantic Avenue, connecting with the Brooklyn tunnel of the Long Island Railroad. There is a loop under Battery Park beginning at Bridge Street. The length of this route is about 3 miles. Every New Yorker and every visitor to Manhattan Island during the past four years is familiar with the tremendous upheaval caused by the execution of that part of the work which lies between the East and North Rivers, extends from the Battery to the Bronx, and now bears immediate fruition. The Brooklyn system will come into play later, and the work on it is now in progress.

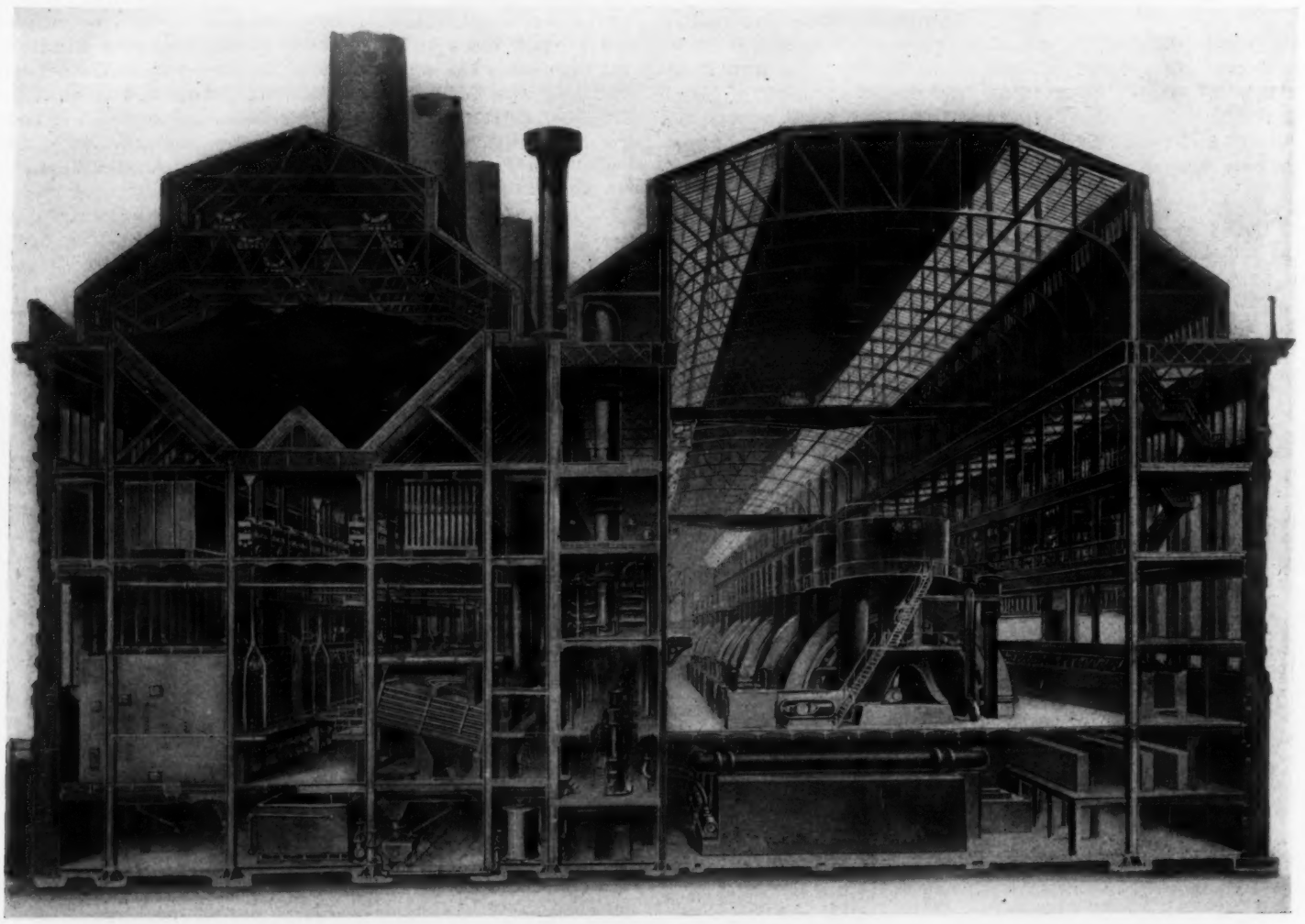


FIG. 3.—CROSS-SECTIONAL VIEW OF POWER HOUSE.

POWER PLANT.

Before taking up questions connected with the tunnel, the track, the equipment of the road, etc., it is pertinent to describe in the pages of the ELECTRICAL WORLD AND ENGINEER the power plant of the system, designed and equipped under the competent planning and supervision of Mr. L. B. Stillwell, electrical director, and Mr. John Van Vleck, mechanical engineer, i. e., the power house situated on

the banks of the North River between West Fifty-eighth and Fifty-ninth Streets. The building shown herewith is already one of the landmarks of the city, and possesses many claims upon the attention of the engineer. The structure is divided into two main parts—an operating room and a boiler house, with a partition wall between the two sections. The face of the structure on Eleventh Avenue is 200 feet wide, of which width the boiler house takes 83 feet and the operating section 117 feet. The operating-room section is practically symmetrical in its structure, with respect to its center; it consists of a central area, with a truss roof over the space, and galleries along both sides. The galleries along the northerly side are primarily for the electrical apparatus, while those along the southerly side are given up chiefly to the steam-pipe equipment. All the structural steel was supplied by the American Bridge Company.

A sectional scheme of the power-house arrangement was determined on by which the structure was to consist of five generating sections, each similar to the others in all its mechanical details; but, at a later date, a sixth section was added, with space on the lot for a seventh section. Each section embraces one chimney along with the following generating equipment:—twelve boilers, two engines, each direct connected to a 5,000-kw alternator; two condensing equipments, two boiler-feed pumps, two smoke-flue systems, and detail apparatus necessary to make each section complete in itself. The only variation is a turbine plant. In addition to the space occupied by the sections, an area was set aside, at the Eleventh Avenue end of the structure, for the passage of the railway spur from the New York Central tracks. The over-all length of the structure is 693 feet 9¾ inches. In the fourth section it was decided to omit a regular engine with its 5,000-kw generator, so that this outfit can afterward be replaced by a regular 5,000-kw traction generator.

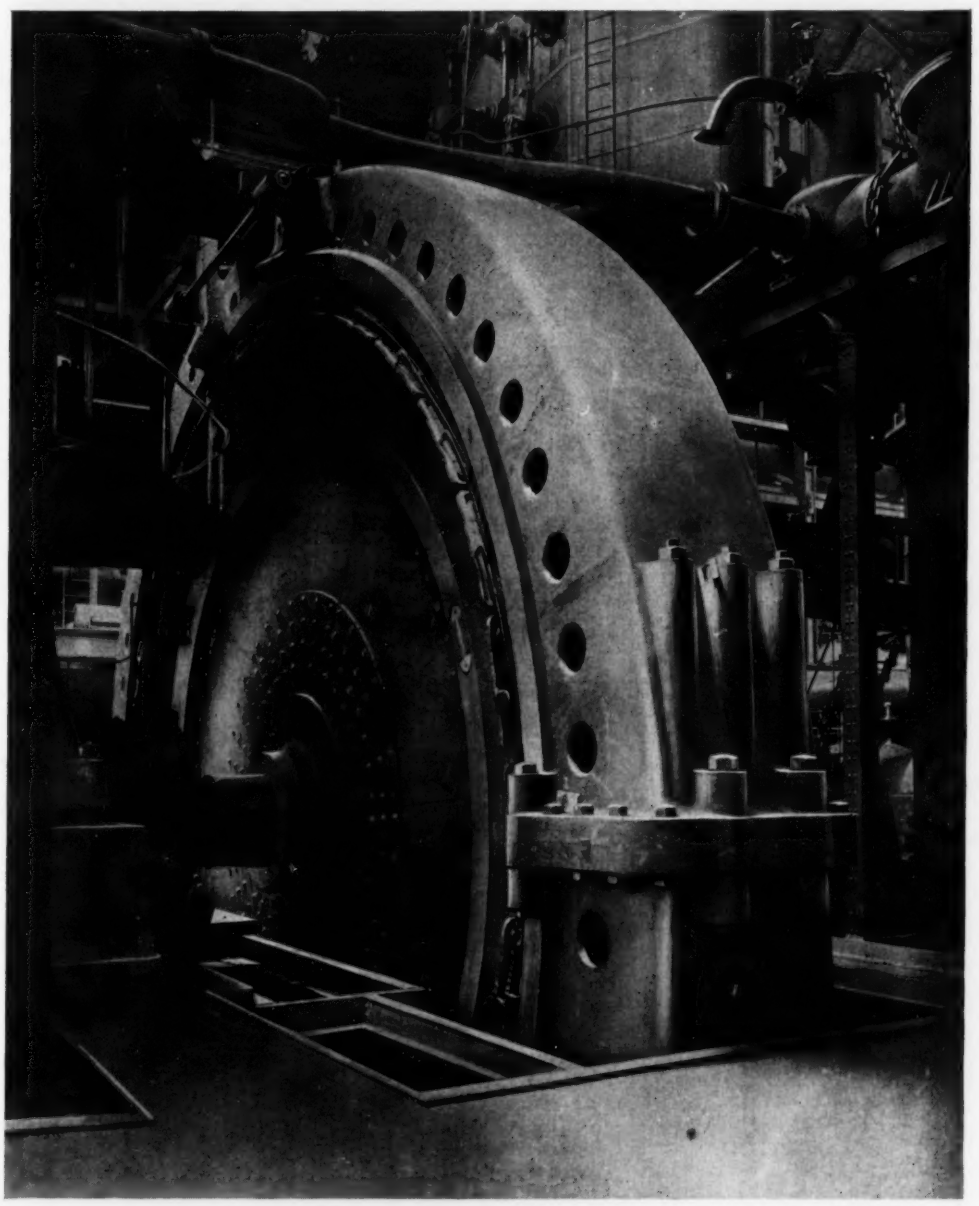


FIG. 4.—ONE OF THE ALTERNATORS.

The plan of the power station included a method of supporting the Alphonse Custodis chimneys on steel columns, instead of erecting them through the building, which modification allowed for the disposal of boilers in spaces which would otherwise be occupied by the chimney bases. By this arrangement it was possible to place all the boilers on one floor level. The economizers were placed above the boilers, instead of behind them, which made a material saving in the width of the boiler room. This saving permitted the setting aside of the afore-mentioned gallery at the side of the operating room, closed off from both boiler and engine-rooms, for the reception of the main pipe systems and for a pumping equipment below it.

The advantages of the plan can be enumerated briefly as follows: The main engines, combined with their alternators, lie in a single row along the center line of the operating room with the steam or operating end of each engine facing the boiler house and the opposite end toward the electrical switching and controlling apparatus arranged along the outside wall. Within the area between the boiler-house and operating room there is placed, for each engine, its respective complement of pumping apparatus, all controlled by and under the operating jurisdiction of the engineer for that engine. Each engineer has thus full control of the pumping machinery required for his unit. Symmetrically arranged with respect to the centre line of each engine are the six boilers in the boiler room, and the piping from these six boilers forms a short connection between the nozzles on the boilers and the throttles on the engine. The arrangement of piping is alike for each engine, which results in a piping system of maximum simplicity that can be controlled in the event of difficulty with a degree of certainty not possible with a more complicated system. The main parts of the steam-pipe system can be controlled from outside this area.

The single tier of boilers makes it possible to secure a high and well-ventilated boiler-room with ventilation into a story constructed above it, aside from that afforded by the windows themselves. The boiler-room will therefore be cool in warm weather and light, and all difficulties from escaping steam will be minimized. In this respect the boiler-room will be superior to corresponding rooms in plants of older construction, where they are low, dark and often very hot during the summer season. The placing of the economizers, with their auxiliary smoke flue connections in the economizer room, all systematically arranged with respect to each chimney, removes from the boiler-room an element of disturbance and makes it possible to pass directly from the boiler-house to the operating-room at convenient points along the length of the power-house structure. The location of each chimney in the center of the boiler-house between sets of six boilers divides the coal bunker construction into separate pockets by which trouble from spontaneous combustion can be localized, and the divided coal can provide for the storage of different grades of coal. The unit basis on which the economizer and flue system is constructed will allow making repairs to any one section without shutting down the portions not connected directly to the section needing repair.

The floor of the power house between the column bases is a continuous mass of concrete nowhere less than two feet thick. The massive concrete foundations for the reciprocating engines contain each 1,400 yards of concrete above mean high-water level, and in some cases have twice as much below that point. The total amount

of concrete in the foundations of the finished power house is about 80,000 yards.

Water for condensing purposes is drawn from the river and discharged into it through two monolithic concrete tunnels parallel to the axis of the building. The intake conduit has an oval interior, 10 by 8½ feet in size, and a rectangular exterior cross-section; the outflow tunnel has a horseshoe-shape cross-section and is built on top of the intake tunnel. Adjacent to the condensing water conduits is a 10 by 15-foot rectangular concrete tunnel, through which the underground coal conveyor is installed between the shore end of the pier and the power house.

The steel structure of the power house is independent of the walls, the latter being self-supporting and used as bearing walls only for a few of the beams in the first floor. Although structurally a single building, in arrangement it is essentially two, lying side by side and separated by a brick division wall. There are 58 traverse and 9 longitudinal rows of main columns, the longitudinal spacing being 18 feet and 36 feet for different rows, with special bracing in the boiler house to accommodate the arrangement of boilers. Both the boiler house and the engine house have five tiers of floor framing below the flat portion of the roof, the three upper tiers of the engine house forming galleries on each side of the operating room, which is clear for the full length of the building. The boiler house floors are, in general, framed with transverse plate girders and longitudinal rolled beams, arranged to suit the particular requirements of the imposed loads of the boilers, economizers, coal, etc., while the engine room floors and pipe and switchboard galleries are in general framed with longitudinal plate girders and transverse beams. There are seven coal bunkers in the boiler house, of which five are 77 feet and two 41 feet in length by 60 feet in width at the top, the combined maximum capacity being 18,000 tons. The bunkers are separated from each other by the six chimneys spaced along the center line of the boiler house. The bottom of the bunkers is at the fifth floor, at an elevation of about 66 feet above the basement.

There are two flue openings, diametrically opposite, and 6 feet wide by 17 feet high to the crown of the arched top. They are lined with fire-brick, which joins the fire-brick lining of the interior of the shaft, this latter being bonded to the red-brick walls to a point 6 feet below the top of the octagon, and extended above for a height of 14 feet within the circular shaft, as an inner shell. The usual baffle-wall is provided of fire-brick, 13 inches thick, extending diagonally across the chimney, and 4 feet above the tops of the flue openings.

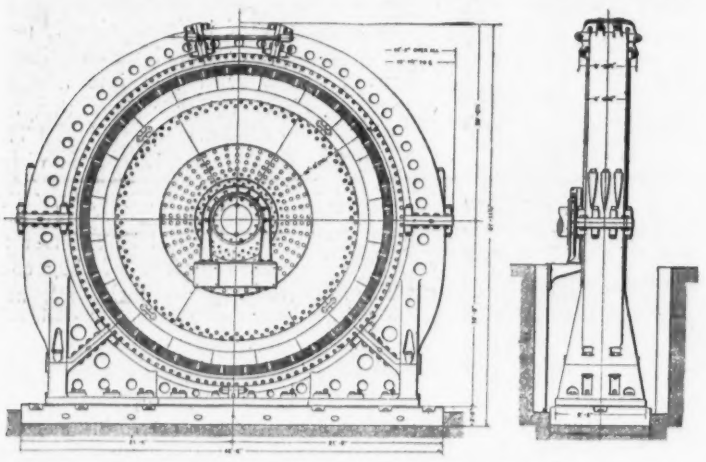


FIG. 5.—SIDE AND END ELEVATIONS OF ALTERNATOR.

Where the chimney passes through the roof of the boiler house, a steel plate and angle curb, which clears the chimney by 6 inches at all points, is provided in connection with the roof framing. This is covered by a hood flashed into the brickwork, so that the roof has no connection with or bearing upon the chimney. At a point 4 feet 6 inches below the cap of the chimney the brickwork is corbeled out for several courses, forming a ledge, around the outside of which is placed a wrought-iron railing, thus forming a walkway around the circumference of the chimney top. The cap is of cast-iron, surmounted by eight 3 by 1-inch wrought-iron ribs, bent over the outlet and with pointed ends gathered together at the centre. The lightning conductors are carried down the outside of the shaft to the roof and thence to the ground outside of the building. Galvanized iron ladder rungs were built in the brickwork, for ladders both inside and outside the shaft. The chimneys, except for the octagonal red-brick base, are constructed of the radial perforated bricks. The lightning rods are tipped with pointed platinum points about 18 inches long.

The design of the facework of the power house received the personal attention of the directors of the company, and its character and the class of materials to be employed were carefully considered. The influence of the design on the future value of the property and the condition of the environment in general were studied, together with the factors relating to the future ownership of the plant by the city. Several plans were taken up looking to the construction of a power house of massive and simple design, but it was finally decided to adopt an ornate style of treatment by which the structure would be rendered architecturally attractive and in harmony with the recent tendencies of municipal and city improvements from an architectural standpoint. The Eleventh Avenue facade is the most elaborately treated, but the scheme of the main facade is carried along both the Fifty-eighth and Fifty-ninth Street fronts. The westerly end of the structure, facing the river, may ultimately be removed in case the power house is extended to the Twelfth Avenue building

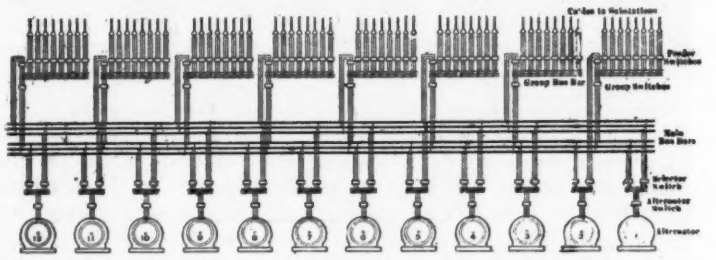


FIG. 6.—GENERAL DIAGRAM OF 11,000-VOLT CIRCUITS IN MAIN POWER STATION.

line for the reception of fourteen generating equipments; and for this reason this wall is designed plainly. The general style of the facework is what may be called French Renaissance, and the color scheme has, therefore, been made rather light in character. The base of the exterior walls has been finished with cut granite up to the water table, above which they have been laid up with a light colored buff pressed brick. This brick has been enriched by the use of similarly colored terra-cotta, which appears in the pilasters, about the windows, in the several entablatures, and in the cornice and parapet work. The Eleventh Avenue facade is further enriched by marble medallions, framed with terra-cotta, and by a title panel directly over the front of the structure. All is incombustible.

Exceptional facilities have been provided for the unloading of coal from vessels, or barges, which can be brought to the northerly side of the recently constructed pier at the foot of West Fifty-eighth Street. The pier was specially built by the Department of Docks and Ferries and is 700 feet long and 60 feet wide.

The pier construction includes a special river wall across Fifty-eighth Street at the bulkhead line through which the condensing water will be taken from and returned to the river. Immediately outside the river wall and beneath the deck of the pier, there is a system of screens through which the intake water is passed. On each side where the water enters the screen chamber, is a heavy steel grillage; inside this is a system of fine screens arranged so that the several screens can be raised, by a special machine, for the purpose of cleaning. The advantages of a well-designed screening outfit have been appreciated, and considerable care has been exercised to make it as reliable and effective as possible.

At each side of the center of the pier, just below the deck, there are two discharge water conduits constructed of heavy timber, to conduct the warm water from the condensers away from the cold water intakes at the screens. Two water conduits are employed in order that one may be repaired or renewed while using the other; in fact, the entire pier is constructed with the view of renewal without interference in the operation for which is was provided.

COAL HANDLING.

The coal-handling equipment, supplied by the Robins Conveying Belt Company, comprises a movable electric hoisting tower with crushing and weighing apparatus—a system of horizontal belt conveyors, with 30-inch belts, to carry the crushed and weighed coal along the dock and thence by tunnel underground to the southwest corner of the power house; a system of 30-inch belt conveyors to elevate the coal a distance of 110 feet to the top of the boiler

house, at the rate of 250 tons per hour or more, if so desired, and a system of 20-inch belt conveyors to distribute it horizontally over the coal bunkers. These conveyors have automatic self-reversing trippers, which distribute the coal evenly in the bunkers. For handling different grades of coal, distributing conveyors are arranged underneath the bunkers for delivering the coal from a particular bunker through gates to the downtake hoppers in front of the boilers.

The equipment, from the same manufacturers, for removing ashes from the boiler-room basement and for storing and delivering the ashes to barges, comprises: A system of tracks, 24 inches gauge, extending under the ash-hopper gates in the boiler-house cellar and extending to an elevated storage bunker at the water front. The rolling stock consists of 24 steel cars of 2 tons capacity, having gable bottoms and side dumping doors. Each car has two four-wheel pivoted trucks with springs. Motive power is supplied by an electric storage-battery locomotive. The cars deliver the ashes to an elevating belt conveyor, which fills the ash bunker. This will contain 1,000 tons, and is built of steel with a suspension bottom lined with concrete. For delivering stored ashes to barges, a collecting belt extends longitudinally under the pocket, being fed by eight gates. It delivers ashes to a loading belt conveyor, the outboard end of which is hinged so as to vary the height of delivery and to fold up inside the wharf line when not in use.

The coal-handling system in question was adopted because any serious interruption of service would be of short duration, as any belt, or part of the belt mechanism, could quickly be repaired or replaced. The system also possesses advantages with respect to the automatic even distribution of coal in the bunkers, by means of the self-reversing trippers. These derive their power from the conveying belts. Each conveyor has a rotary cleaning brush to cleanse the belt before it reaches the driving pulley and they are all driven by induction motors.

The tower frame and boom are steel. The tower rolls on two rails along the dock and is self-propelling. The lift is unusually short; for the reason that the weighing apparatus is removed horizontally to one side in a separate house, instead of lying vertically below the crusher. This arrangement reduces by 40 per cent. the lift of the bucket, which is of the clam-shell type of 44 cubic feet capacity. The motive power for operating the bucket is perhaps the most massive and powerful ever installed for such service. The main hoist is directly connected to a 200-hp motor with a special system of control. The trolley engine for hauling the bucket along the boom is also direct-coupled to a multipolar motor.

The receiving hopper has a large throat, and a steel grizzly in it which sorts out coal small enough for the stokers and bypasses it around the crusher. The crusher is of the two-roll type, with relieving springs, and is operated by a motor, which is also used for propelling the tower. The coal is weighed in duplex two-ton hoppers.

The coal from the coal bunkers is allowed to flow down into the boiler room through two rows of downtakes, one on each side of the central gangway or firing place. Each bunker has eight cast-iron outlets, four on each side, and to these outlets are bolted gate valves for shutting off the coal from the corresponding downtakes. From these gates the downtakes lead to hoppers which are on the economizer floor, and from these hoppers the lower sets of downtakes extend down to the boilers.

Just above the hoppers on the economizer floor the coal downtakes are provided with valves and chutes to feed the coal, either into the hopper or into the distributing flight conveyor alongside of it. These distributing conveyors, one corresponding with each row of downtakes, permit the feeding of coal from any bunker or bunkers to all the boilers when desired. They are the ordinary type of flight conveyor, capable of running in either direction and provided with gates in the bottom of the trough for feeding into the several above-mentioned hoppers. In order to eliminate the stresses that would develop in a conveyor of the full length of the building, the conveyors are of half the entire length, with electric driving motors in the center of each continuous line. The installation of this conveyor system, in connection with the coal downtakes, makes it possible to carry a high-grade coal in some of the bunkers for use during periods of heavy load and a cheaper grade in other bunkers for the periods of light load.

THE BOILER PLANT.

The main boiler room is designed to receive ultimate seventy-two safety water-tube, three-drum boilers, each having 6,008 square feet of effective heating surface, by which the aggregate heating surface of the boiler room will be 432,507 square feet. There are fifty-two boilers, furnished by the Babcock & Wilcox Co., erected in pairs, or batteries, and between each battery is a passageway five feet wide. The boilers are designed for a working steam pressure of 225 pounds per square inch and for a hydraulic test pressure of 300 pounds per square inch. Each boiler is provided with twenty-one vertical water-tube sections, and each section is fourteen tubes high.

The setting of the boiler embodies several special features which are new in boiler erection. The boilers are set higher up from the floor than in standard practice, the center of the drums being 19 feet above the floor line. This feature provides a higher combustion chamber, for either hand-fired grates or automatic stokers; and for inclined grate stokers the fire is carried well up above the supporting girders under the side walls, so that these girders will not be heated by proximity to the fire. As regards the masonry setting, practically the entire inside exposed to the hot gases is lined with a high grade of firebrick. The back of the setting, where the

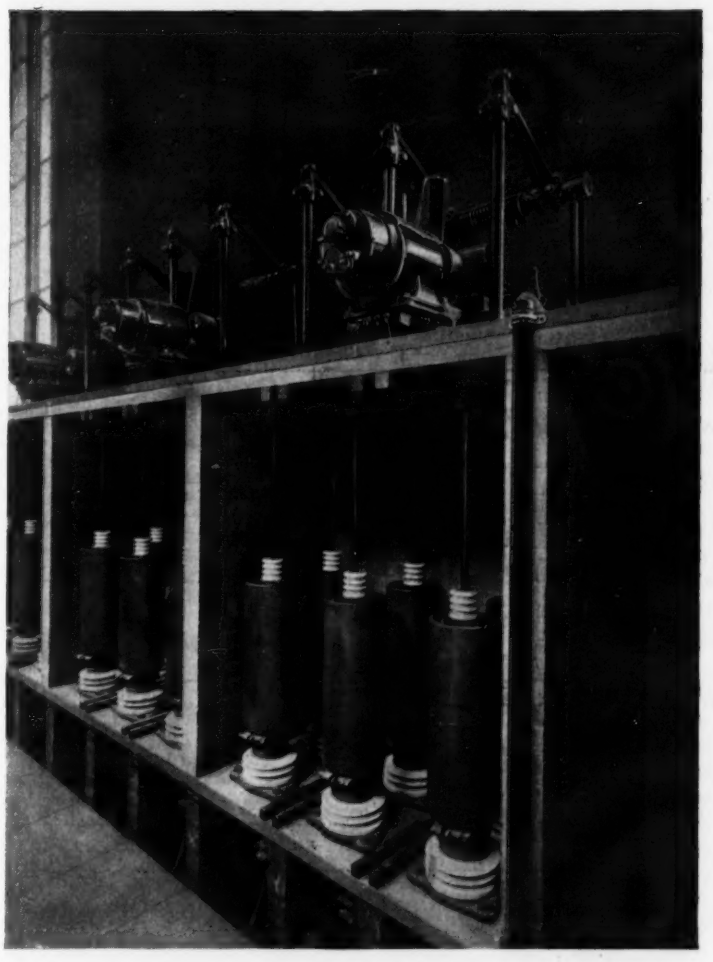


FIG. 7.—MOTOR-OPERATED OIL SWITCHES.

rear cleaning is done, is provided with a sliding floor plate, which is used when the upper tubes are being cleaned. There is also a door at the floor line and at a higher level for light and ventilation when cleaning. Over the tubes arrangements have been made for the reception of superheating apparatus without changing the brickwork. Where the brick walls are constructed, at each side of the building columns at the front, cast-iron plates are erected to a height of 8 feet on each side of the column. An air space is provided between each cast-iron plate and the column, which is accessible for cleaning from the boiler front; the object of the plates and air space being to prevent the transmission of heat to the steel columns.

In front of all the boilers is a continuous platform of open-work cast-iron pipes, laid on steel beams, the level of the platform being 8 feet above the main floor. The platform connects across the firing area, opposite the walk between the batteries, and at these points this platform is carried between the boiler settings. Each boiler is provided with two water columns, one on each outside drum, and each boiler will have one steam gauge above the plat-

form for the water tenders and one below the platform for the firemen. The stop and check valves on each boiler drum have been made specially heavy for the requirement of this power house, and this special increase of weight has been applied to all the several minor boiler fittings. Hand-fired Gibson grates of the shaking pattern have been furnished for thirty-six boilers, and for each of these grates a special lower front has been constructed. These fronts are of sheet steel, and the coal passes down to the floor through two steel buckstays which have been enlarged for the purpose. There are three firing doors and the sill of each door is 36 inches above the floor. The gate area of the hand-fired grates is 100 square feet, being 8 feet deep by 12 feet 6 inches wide. The twelve boilers, which will receive coal from the coal bunker located between the fourth and fifth chimneys, have been furnished with automatic stokers. It is proposed to employ superheaters to the entire boiler plant.

The boiler-room ceiling has been made especially high, and in this respect the room differs from most power houses of similar construction. The distance from the floor to the ceiling is 35 feet, and from the floor plates over the boilers to the ceiling is 13 feet. Over each boiler is an opening to the economizer floor above, covered with an iron grating. The height of the room, as well as the feature of these openings, and the stairway wells and the large extent of window opening in the south wall, will make the room light and especially well ventilated. Under these conditions the intense heat usually encountered over boilers will largely be obviated. In addition to making provisions for the air to escape from the upper part of the boiler room, arrangements have been provided for allowing the air to enter at the bottom. This inflow of air will take place through the southerly row of basement windows, which extend above the boiler-room floor, and through the wrought-iron open-work floor construction extending along in the rear of the northerly row of boilers.

In order to burn the finer grades of anthracite coal in sufficient quantities to obtain rating with the hand-fired grates, and in order to secure a large excess over boiler rating with other coals, a system of blowers and air ducts has been provided in the basement under the boilers. One blower is set apart for every three boilers, with arrangements for supplying all six boilers from one blower. The Sturtevant blowers are 11 feet high above the floor and 5 feet 6 inches wide at the floor line. Each blower is direct-connected to a two-crank 7½ by 13 by 6½-inch upright, automatic, compound, steam engine of the self-enclosed type, and is to provide a sufficient amount of air to burn 10,000 pounds of combustible per hour with 2 inches of water pressure in the ash pits.

The twelve boilers for each chimney are each provided with two round smoke uptakes, which carry the products of combustion upward to the main smoke-flue system on the economizer floor. A main smoke flue is provided for each group of three boilers, and each pair of main smoke flues joins together on the center line of the chimney, where in each case one common flue carries the gases into the side of the chimney. The two common flues last mentioned enter at opposite sides of the chimney. The main flues are arranged and fitted with dampers, so that the gases can pass directly to the chimney, or else they can be diverted through the economizers and thence reach the chimney.

The sectional plan on which the power house is designed has made a uniform and simple arrangement of steam piping possible with the piping for each section, except that of the turbine bay, identical with that for every other section. A cross-over pipe is erected on each boiler, so that by a combination of valves and fittings the steam may be passed through the superheater. In the delivery from each boiler a quick closing 9-inch valve is provided, which can be closed from the boiler-room floor by hand or from a distant point individually or in groups of six. Risers with 9-inch wrought-iron goose necks then connect each boiler to the steam main, where 9-inch angle valves are inserted in each boiler connection. These valves can be closed from the platform over the boilers, and are grouped three over one set of three boilers and three over the opposite set.

The main from the six boilers is carried directly across the boiler house in a straight line to a point in the pipe area where it rises to connect to the two 14-inch steam downtakes to the engine throttles. At this point the steam can also be led downward to a manifold to which the compensating tie lines are connected. These compensating lines are run lengthwise through the power house for the purpose of joining the systems together, as desired. The two downtakes to the engine throttles drop to the basement, where each, through a goose-neck, delivers into a receiver and separating tank and from the tank through a second goose-neck into the corresponding throttle.

A quick-closing valve appears at the point where the 17-inch pipe divides into the two 14-inch downtakes and a similar valve is provided at the point where the main connects to the manifold. The first valve will close the steam to the engine and the second will control the flow of steam to and from the manifold. These valves can be operated by hand from a platform located on the wall inside the engine room, or they can be closed from a distant point by hydraulic apparatus. In the event of accident the piping to any engine can be quickly cut out or that system of piping can quickly be disconnected from the compensating system.

The pipe area containing, as mentioned, the various valves described, together with the manifolds and compensating pipes, is divided by means of cross-walls into sections corresponding to each pair of main engines. Each section is thus separated from those adjoining, so that any escape of steam in one section can be localized and, by means of the quick-closing valves, the piping for the corresponding pair of main engines can be disconnected from the rest of the power house. All flanges and bolts are 50 per cent. heavier than the "extra heavy" proportions ordinarily recognized.

The feed water will enter the building at three points, the largest water service being 12 inches in diameter, which enters the structure

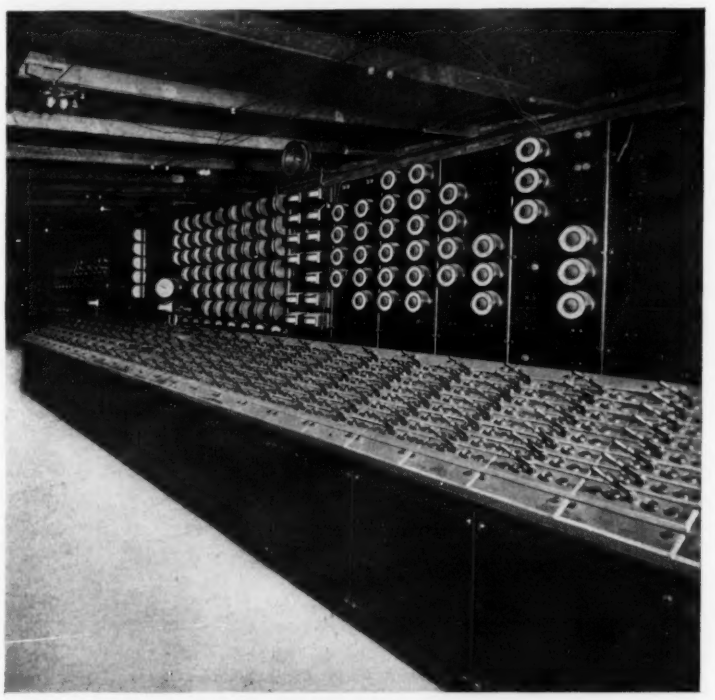


FIG. 8.—CONTROL AND INSTRUMENT BOARD, MAIN STATION.

at its southeast corner. The water first passes through fish traps and thence through meters, and from them to the main reservoir tanks, arranged along the center of the boiler-house basement. The water is allowed to flow into each tank by means of an automatic float valve. The water will be partly heated in these reservoir tanks by means of hot water discharged from high-pressure steam traps. In this way the heat contained in the drainage from the high-pressure steam is, for the most part, returned to the boilers. From the reservoir tanks the water is conducted to the feed-water pumps, by which it is discharged through feed-water heaters where it is further heated by the exhaust steam from the condensing and feed-water pumps. From the feed-water heaters the water will be carried direct to the boilers; or through the economizer system to be further heated by the waste gases from the boilers.

Like the steam-pipe system, the feed-water piping is laid out on the sectional plan, the piping for the several sections being identical, except for the connections from the street service to the reservoir tanks. The feed-water piping is constructed wholly of cast-iron, except the piping above the floor line to the boilers, which is of extra-heavy semi-annealed brass with extra-heavy cast-iron fittings.

THE STEAM ENGINES.

The engine and turbine equipment under contract embraces nine

8,000 to 11,000 hp main engines, direct-connected to 5,000-kw generators, three steam turbines, direct-connected to 1,875-kw lighting generators, and two 400-hp engines, direct-connected to 250-kw exciter generators.

The main engines, furnished by the Allis-Chalmers Company, are similar in type to those installed in the Seventy-fourth Street power house of the Manhattan division of the Interborough Rapid Transit Company, i. e., each consists of two component compound engines, both connected to a common shaft, with the generator placed between the two component engines. As a comparison of various dimension and features of the Manhattan and Rapid Transit engines may be of interest, the accompanying tabulation is submitted:

	Manhattan.	Rapid Transit.
Diameter of high-pressure cylinders, inches.	44	42
Diameter of low-pressure cylinders, inches..	88	86
Stroke, inches	60	60
Speed, revolutions per minute	75	75
Steam pressure at throttle, pounds	150	175
Indicated horse-power at best efficiency....		
Diameter of low-pressure piston rods, inches	8	10
Diameter of high-pressure piston rods, ins..	8	10
Diameter of crank pin, inches.....	18	20
Length of crank pin, inches.....	18	18
Type of Low Pressure Valves.	Double ported Corliss	Single ported Corliss
Type of High Pressure Valves.	Corliss.	Poppet Type.
Diameter of shaft in journals, inches.....	34	34
Length of journals, inches.....	60	60
Diam. of shaft in hub of revolv. elem't, ins.	37 1-16	37 1-16

The engine will be capable of operating continuously when indicating 11,000 hp with 175 pounds of steam pressure, a speed of 75 revolutions and a 26-in. vacuum. It will not require more than 12¼ pounds of dry steam per indicated horse-power per hour, when indicating 7,500 hp at 75 r.p.m., with the vacuum of 26 in. at the low-pressure cylinders, with a steam pressure at the throttle of 175 pounds and with saturated steam at the normal temperature due to its pressure. The guarantee includes all of the steam used by the engine or by the jackets or reheater.

The new features contained within the engine construction are principally: the novel construction of the high-pressure cylinders, by which only a small strain is transmitted through the valve chamber between the cylinder and the slide-surface casting. This is accomplished by employing heavy bolts, which bolt the shell of the cylinder casting to the slide-surface casting, said bolts being carried past and outside the valve chamber. Second, the use of poppet valves, which are operated in a very simple manner from a wrist plate on the side of the cylinder, the connections from the valves to the wrist plate and the connections from the wrist plate to the eccentric being similar to the parts usually employed for the operation of Corliss valves.

Unlike the Manhattan engines, the main steam pipes are carried to the high-pressure cylinders under the floor and not above it. Another modification consists in the use of an adjustable strap for the crank pin boxes instead of the marine style of construction at the crank pin end of the connecting rod.

The weight of the revolving field is about 335,000 pounds, which gives a fly-wheel effect of about 350,000 pounds at a radius of gyration of 11 ft., and with this fly-wheel inertia the engine is designed so that any point on the revolving element shall not, in operation, lag behind nor forge ahead of the position that it would have if the speed were absolutely uniform, by an amount greater than one-eighth of a natural degree.

Arrangements have been made for the erection of four turbo-generators, but only three of Westinghouse type have been ordered. They are of the multiple expansion parallel flow type, consisting of two turbines arranged tandem compound. When operating at full load each of the two turbines, comprising one unit, will develop approximately equal power for direct connection to an alternator giving 7,200 alternations per minute at 11,000 volts and at a speed of 1,200 r.p.m. Each unit will have a normal output of 1,700 electrical hp with a steam pressure of 175 pounds at the throttle and a vacuum in the exhaust pipe of 27 in., measured by a mercury column and referred to a barometric pressure of 30 in. The turbine is guaranteed to operate satisfactorily with steam superheated to 450° F. The economy guaranteed under the foregoing conditions as to initial and terminal pressure and speed is as follows: Full load of 1,250 kw, 15.7 pounds of steam per electrical hp-hour; three-quarter load, 937½ kw, 16.6 pounds per electrical hp-hour; one-half load, 625 kw, 18.3 pounds; and one-quarter load, 312½ kw, 23.2 pounds. When operating under the conditions of speed and steam pressure mentioned, but with a pressure in the exhaust pipe of 27 in. vacuum by mercury column (referred to 30 in. barometer), and with steam at the throttle superheated 75° F. above the temperature of saturated steam at that pressure, the guaranteed steam consumption is as follows: Full load, 1,250 kw, 13.8 pounds per electrical hp-hour; three-quarter load, 437½ kw, 14.6 pounds; one-half load, 625 kw, 16.2 pounds; and one-quarter load, 312½ kw, 20.8 pounds.

The two exciter engines are each direct-connected to a 250-kw, direct-current generator. Each engine is a vertical quarter-crank compound engine with a 17-in. high-pressure cylinder and a 27-in. low-pressure cylinder with a common 24-in. stroke. The engines will be non-condensing, for the reason that extreme reliability is desired at the expense of some economy. They will operate at best efficiency when indicating 400 hp at a speed of 150 r.p.m., with a steam pressure of 175 pounds at the throttle. Each engine will have a maximum of 600 indicated hp.

Each engine unit is supplied with its own condenser equipment, consisting of two barometic condensing chambers, each attached as closely as possible to its respective low-pressure cylinder. For each engine also is provided a vertical circulating pump along with a vacuum pump and, for the sake of flexibility, the pumps are cross-connected with those of other engines and can be used interchangeably. The condensing equipment was supplied by the Alberger Condenser Company.

The circulating pumps are vertical, cross-compound pumping engines with outside packing plungers. Their foundations are upon the basement floor level and the steam cylinders extend above the engine room floor; the starting valves and control of speed is, therefore, entirely under the supervision of the engineer. Each pump has a normal capacity of 10,000,000 gallons of water per day, so that the total pumping capacity of all the pumps is 120,000,000 gallons per day. While the head against which these pumps will be required to work, when assisted by the vacuum in the condenser, is much less than the total lift from low tide water to the entrance into the condensing chambers, they are so designed as to be ready to deliver the full quantity the full height, if for any reason the assistance of the vacuum should be lost or not available at times of starting up. A temporary overload can but reduce the vacuum only for a short time and the fluctuations of the tide, or even a complete loss of vacuum cannot interfere with the constant supply of water, the governor simply admitting to the cylinders the proper amount of steam to do the work. The high-pressure steam cylinders are 10 in. in diameter and the low-pressure are 20 in.; the two double-acting water plungers are each 20 in. in diameter, and the stroke is 30 in. for all. The water ends are composition fitted for salt water and have valve decks and plungers entirely of such material.

The dry vacuum pumps are of the vertical form, and each is located alongside of the corresponding circulating pump. The steam cylinders also project above the engine room floor. The vacuum cylinder is immediately below the steam cylinder and has a valve that is mechanically operated by an eccentric on the shaft. These pumps are of the close-clearance type, and, while controlled by a governor, can be changed in speed while running to any determined rate. From each atmospheric exhaust valve, which is direct-connected to the condensing chamber at each low-pressure cylinder, is run downward a 30-in. riveted-steel exhaust pipe. At a point just under the engine room floor the exhaust pipe is carried horizontally around the engine foundations, the two from each pair of engines uniting in a 40-in. riser to the roof. This riser is between the pair of engines and back of the high-pressure cylinder, thus passing through the so-called pipe area, where it also receives exhaust steam from the pump auxiliaries. At the roof the 40-in. riser is run into a 48-in. standpipe. This is capped with an exhaust head, the top of which is 35 ft. above the roof.

For the lubrication of the engines an extensive oil-distributing and filtering system is provided. The piping to the engines is constructed on a duplicate, or crib, system, by which the supply of oil cannot be interrupted by a break in any one pipe. The oil on leaving the engines is conducted to the filtering tanks. A pumping equipment then redelivers the oil to the elevated storage tanks. All piping carrying filtered oil is of brass and fittings are inserted at proper pipes to facilitate cleaning. The immediate installation includes two oil filtering tanks at the easterly end of the power house, but the completed plant contemplates the addition of two extra filtering tanks at the westerly end of the structure.

The power house is provided with the following traveling cranes: For the operating room—one 60-ton electric traveling crane and one 30-ton electric traveling crane. For the area over the oil switches—one 10-ton, hand-operated crane. For the center aisle of the boiler room—one 10-ton, hand-operated crane. The span of both of the electric cranes is 74 ft. 4 in. and both cranes operate over the entire length of the structure. The 60-ton crane has two trolleys, each with a lifting capacity, for regular load, of 50 tons. Each trolley is also provided with an auxiliary hoist of 10 tons capacity.

THE ELECTRICAL GENERATORS.

The electrical system adopted is that of three-phase generation at 11,000 volts, 25 cycles, with transformation and conversion to direct current for the third rail at 625 volts.

The alternators built for this plant by the Westinghouse Electric & Manufacturing Company closely resemble those installed by the Manhattan Railway Company (now the Manhattan division of the Interborough Rapid Transit Company) in its plant on the East River, between Seventy-fourth Street and Seventy-fifth Street. They differ, however, in having the stationary armature divided into seven casings instead of six, and in respect to details of the armature winding. They are three-phase machines, delivering 25-cycle alternating current at an effective potential of 11,000 volts. They are 42 ft. in height, the diameter of the revolving part is 32 ft., its weight 332,000 pounds, and the aggregate weight of the machine 889,000 pounds. The design of the engine dynamo unit eliminates the auxiliary fly-wheel, the weight and dimensions of the revolving alternating field being such with reference to the turning moment of the engine as to secure close uniformity of rotation, while at the same time this construction results in narrowing the engine and reducing the engine shafts between bearings.

Construction of the revolving parts of the alternators is such as to secure very great strength and consequent ability to resist the tendency to burst and fly apart in case of temporary abnormal speed through accident of any kind. The hub of the revolving field is of cast steel, and the rim is carried not by the usual spokes but by two wedges of rolled steel. The angular velocity of the revolving field is remarkably uniform. This result is due primarily to the fact that the turning movement of the four-cylinder engine is far more uniform than is the case, for example, with an ordinary two-cylinder engine. The large fly-wheel capacity of the rotating element of the machine also contributes materially to secure uniformity of rotation.

The alternators have forty field poles and operate at 75 r.p.m. The field magnets constitute the periphery of the revolving field, the poles and rim of the field being built up by steel plates, which are dovetailed to the driving spider. The heavy steel end plates are bolted together, the laminations breaking joints in the middle of the pole. The field coils are secured by copper wedges, which are subjected to shearing strains only. In the body of the poles, at intervals of approximately three inches, ventilating spaces are provided, these spaces registering with corresponding air ducts in the external armature. The field winding consists of copper strap on edge, one layer deep, with fibrous material cemented in place between turns, the edges of the strap being exposed.

The armature is stationary and exterior to the field. It consists of a laminated ring with slots on its inner surface and supported by a massive external cast-iron frame. The armature, as has been noted, comprises seven segments, the topmost segment being in the form of a small keystone. This may be removed readily, affording access to any field coil, which in this way may be easily removed and replaced. The armature winding consists of U-shaped copper bars in partially closed slots. There are four bars per slot and three slots per phase per pole. The bars in any slot may be removed from the armature without removing the frame. The alternators, of course, are separately excited, the potential of the exciting current used being 250 volts and five 250-kw machines for such work and for motor current are provided, driven by engines of 400 hp, supplemented by a "Chloride" storage battery of 3,000 amp. capacity for one hour, supplied by the Electric Storage Battery Company.

Views are shown herewith of the main switchboard and of the oil switches, but details as to the part of the work as well as in regard to the sub-stations must be reserved for a succeeding article. Incidentally, it may be noted here that provision has been made for 12 sub-stations, while 8 are being put into operation at the present time.

A Gas Engine Harbor Electric Plant.

THE new harbor which the Midland Railway Company has built in Morecambe Bay for the Isle of Man and Irish traffic has many features of interest from the point of view of the engineer. The most unusual feature of the works lies in the fact that electric power is employed for practically all machines. Not only does electricity effect considerable economies in working, as compared with hydraulic and steam power for the actuation of the cranes, capstans, lifts, pumps, etc., which constitute the bulk of power using machinery in harbor works, but it also imparts an elasticity to the power distribution scheme otherwise unobtainable without loss of efficiency. Where extensions are probable, this consideration naturally has much weight, and no doubt it did much to influence the Midland Railway Company's engineers in favor of the motor drive.

From the generating station power and lighting feeders are run to sub-switchboards at three distribution points, known as A, B and C. Of these A and B are inside freight sheds on the south side of the large basin now completed, where are the passenger and freight landing stages. Point C is on the north side of the harbor, where the fish traffic will be handled. The system is three-wire, direct current, with 460 volts between the outer wires for the supply to motors, and 230 volts between middle wire and outers for incandescent lighting. The arc lamps are run two in series on 230 volts.

The two sub-switchboards in the freight sheds are connected together by balancing mains, so as to form a ring system, and are furnished with reverse-current circuit-breakers and with coupling switches for connecting the lighting feeders to the power bus-bars, or vive versa, thus allowing each board to be fed from either power or lighting feeders. From these two boards feeders are taken to twenty 100-amp. water-tight plugs for supplying the seven wharf cranes, other feeders being carried to supply seven platform cranes in the sheds, and twelve capstans.

The feeders from the power house to the distribution points are all carried overhead, on a double-H, 40-ft. pole line, all the poles being set in concrete. At the last group of poles, close to the power house, the cables are carried down and into the power house through a trench running behind and below the main switchboard. The overhead conductors are lightly insulated, and hung by means of leather suspenders from No. 6 galvanized wire, made off on oil shackles at every pole.

The docks, including landing stages, cart roads, sidings, passenger station, large and small freight sheds, engine house, etc., are lighted by 106 4-amp. arc lamps, each fitted with Siemens patent raising and lowering gear, and the equivalent of 1,000 16-cp incandescent lamps. To compensate for the heavy tidal rise, which is often as much as 20 ft., it has been necessary to provide three landing stages, one above the other. As portions of the wiring for the lighting of lower and middle stages are submerged twice in each 24 hours, the wires are run in galvanized screwed heavy gauge steel piping, which is calculated to resist these unfavorable conditions. The lamps are, of course, also submerged, and are, therefore, enclosed in specially designed water-proof fittings. The lighting of the quayside is carried out by means of two-light fittings run on alternate circuits and carried in lanterns on 10-ft. cast-iron pillars, spaced about 60-ft. apart.

The electric power is generated by three gas-driven, direct-current units in the power house illustrated in Figs. 1 and 2. The producer gas is of the Mond type, and is generated in a producer plant installed on the premises. As gas production plants are now a subject of considerable interest, a description in detail will be given of that installed here.

The air blast for producing the gas is delivered by a blower, and, after passing along the air main, enters at the bottom of the air tower. In this tower the air comes into intimate contact with the water, which has been heated by the gas cooling tower, and is thereby saturated with water vapor at the temperature at which it leaves the latter. The air heating tower is packed with circular earthenware tiles down which the water trickles, meeting the air as it rises to the top. It leaves the air tower at the outlet, and after passing along the air main, where it receives a further supply of steam in the shape of exhaust, enters the external pipe of the superheater. The superheater consists of two legs, each one having an internal and an external pipe. The external pipe forms an

annular space, through which the hot blast passes, and is therein superheated by means of the hot gas, which is passing in the opposite direction from the producer, through the internal pipes of the superheater. The superheated blast now enters the producer.

The producer is cylindrical in shape, and consists of an internal and external wrought-iron shell. The internal one is lined with fire brick as far down as the fire bar casting, and has the shape of an internal cone at the bottom; the external shell, however, is cylindrical down to the water seal wherein it is luted with water. The great advantage of this water seal is that it enables ashes to be withdrawn while the producer is in operation. In the upper part of the producer, immediately beneath the fuel hopper, is an internal bell, which, by being kept full of fuel, automatically maintains the proper height of fuel in the body of the producer itself, and thus assists in maintaining uniformity of composition in the gas. The bell further obviates the serious fluctuation in pressure throughout the plant, which would be brought about if the fuel were dropped straight into the producer, and by providing for partial distillation of the "green" fuel before entering the main body of the producer, reduces, to some extent, the amount of tar produced. In the lower part of the outer shell there are one manhole door and 12 sight holes. Each producer—there are two units—is further provided with four poke holes for poking into the interior of the bell, eight for poking in between the bell of the producer and the shell, and four ball poke holes on the dome of the producer for examining the interior and poking the fuel. A circular platform is provided for working the coal feeding apparatus and the various poke holes.

The blast entering the producer from the superheater passes all round the annular space between the internal and external shells, and enters the interior at the fire bars at the bottom. The resultant gas, under ordinary circumstances, when working on a good load and consuming suitable Nottinghamshire or Lancashire slack, will have a composition approximately as follows:

Carbonic acid, CO_2	12	per cent.
Carbonic oxide, CO	17	"
Hydrogen, H	21	"
Marsh gas CH_4	2	"
Nitrogen, N	48	"
	100	per cent.

After leaving the producer the gas passes through the internal pipe of the superheaters, giving up on the way a considerable portion of its heat to the air, passing through the annular space between the internal and external pipes. The gas, having deposited a great part of its suspended dust in the superheaters, enters the gas collecting main. Here more dust is lost; the dust is daily removed from dust boxes.

The washer, into which the gas passes from the collecting main, consists of a water luted wrought-iron vessel, roughly rectangular in shape, in which revolves a dasher fitted with blades of suitable form, which throw very fine spray into the gas as it passes through. The remainder of the dust in the gas is thus thrown out and deposited in the water, some of it sinking to the bottom, and some remaining on the top. The washer is provided with suitable lutes at the sides in which the dust collects, and from which it is removed periodically. The dust, etc., which sinks to the bottom of the water may be removed while the plant is working, by means of rakes and scoops provided for the purpose.

From the washer the gas enters the bottom of the gas cooling tower. This tower is cylindrical in shape and contains earthenware tiles, similar to those in the air tower already described. The gas passes up the tower, coming into intimate contact, on the way, with water trickling down the tiles, which has been cooled by the ingoing air. It will thus be seen that in the air tower and gas tower there is a continual circulation of the same water. The gas gives up its heat to the cooling water, which is then pumped to the top of the heating tower, in which it is cooled by the incoming air, which becomes saturated with steam on its way to the producer. It is, therefore, obvious that a general regeneration of steam is taking place in these towers. The water delivered from the towers is freed from the bulk of its tar in tanks before passing to the pumps.

From the cooling tower the gas passes along to the gas holder, which is so arranged as to automatically limit the amount of gas made to supply exactly what has been consumed. After leaving the holder the gas enters a fan, in which it is dashed with great force against the sides, and the remaining tar thus thrown out. In this fan the gas is considerably cooled by means of cold water supplied to it. The fan now forces the gas through the sawdust scrubber, which is packed with coarse shavings and sawdust. In this apparatus the remaining particles of tar are removed, and the gas is left in a pure condition, ready for consumption in the engines, and having an average calorific value of 145 British thermal units per cubic foot.

From Fig. 3, which is a plan of the entire power plant, the arrangement of the producers will be seen at a glance. A small machinery house, the roof of which is utilized to support water

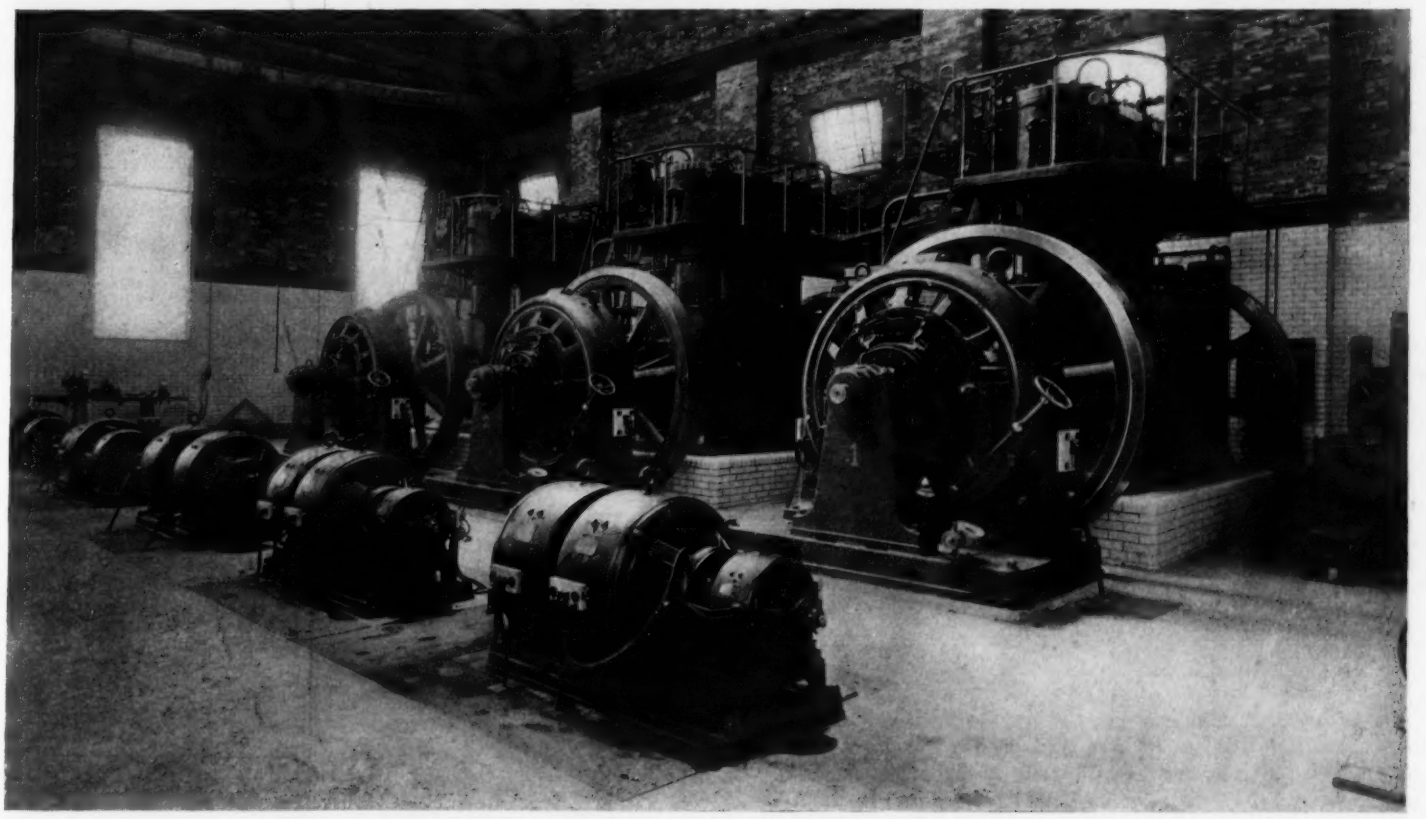


Fig. 1.—150-hp Motor-Driven Sets, Boosters and Balancing Sets.

storage tanks, contains a small steam engine, which drives the pumps and blowers for the producers by means of shafting and belting. Round one end and alongside the machinery house are the gas holder, scrubber, fan, settling tank and two circulating tanks. One gas tower and one air tower only are supplied, but there is a superheater for each of the two producers. With a view to extension, space has been allowed for an additional producer, with superheater, additional gas and air towers, circulating tanks, washer, scrubber and fan.

The coal used in the producers is bituminous slack, and each unit has capacity to gasify 700 pounds per hour. The slack is dumped from railway wagons direct into the elevator boot, and then raised by a bucket conveyor, which deposits it in a horizontal spiral conveyor, running across the tops of bunkers above each producer. Each bunker holds ten tons of small coal, and an Avery patent automatic weighing machine is fitted to each, to enable an accurate record of the consumption to be kept. The conveyors are driven by a 7½-hp Westinghouse motor, shunt-wound, running at 1850 r.p.m.

From the scrubber the gas passes into the gas main, which runs outside the engine house alongside the three 250-hp gas engines.

FIG. 2.—GENERAL VIEW OF POWER STATION AND PRODUCER PLANT.

The gas is supplied to the engines through a regulator, from which it emerges practically at atmospheric pressure. The engines are of the Westinghouse vertical single-acting pattern and run at the comparatively high speed of 200 r.p.m. The three cylinders are each 20 in. × 22 in., and the engines work on the Otto cycle, with high compression and electrical ignition. The quality of the mixture is not varied, and explosions are never passed, as in the "hit and miss" method of governing, so that the resultant speed regulation is very close. The engines are started by compressed air, stored in a battery of tanks charged by two small Westinghouse motor-driven air compressors.

Each gas engine is direct-coupled to a 150-kw, direct-current generator of standard Westinghouse pattern, giving a voltage of 430 to 460 volts and 325 amp. when working at normal speed. The machines are shunt wound, and the armature windings are of the balanced type, so that no undue pull will be exerted on the bearings should the armature get out of center. The machines have eight poles, the pole pieces being laminated and cast into the vertically divided field frames.

From the dynamos leads are brought in trenches covered with iron checker plates to the main switchboard, which consists of twenty panels of black enameled slate. Starting from the left hand, facing the board, the arrangement is as follows: First come three positive generator panels, then the positive battery panel. Then come two panels of which one will be blank and the other for the control of various sub-boards. Next come a feeder panel, positive booster panels for power and for lighting, a panel for the middle wire of the three-wire system and the negative panels for the power and lighting feeder boosters. Then come a blank panel and a sub-board panel, not yet in place, battery booster panel, battery negative panel, and three negative generator panels, completing the board.

The auxiliary apparatus in the power house includes at present two battery boosters, one balancer and a power and a lighting feeder booster. The battery boosters, which are automatically reversible, consist each of a shunt-wound motor, driving an 18-kw booster generator and an exciter of 5 kw. The booster motors are connected in series across the three-wire system, and can be used as a balancer, the two sets being then mechanically coupled together. The booster itself is separately excited by the small exciter on the same shaft, this exciter being connected to the bus-bars, and the other to a very low resistance shunt in the bus-bars between the main generators and the outgoing feeders. In addition to the field winding through which the exciter current passes, the boosters have a series winding on their fields, carrying the main current, which gives a cumulative effect.

Each battery booster can increase the pressure from 0—80 volts, for charging at 200 amp., and decrease it 0—45 volts on discharging up to 300 amp., and can also be set to work automatically on varying loads so as to charge up to 200 amp. and discharge up to 300 amp. as loads vary. The speed is 950 r.p.m.

The balancer consists of two machines, each of 24 kw capacity at 30—240 volts. The power and lighting feeder booster sets consist each of three machines, a 20-hp motor in the middle, and a 7.5-kw generator on either side.

The storage battery of the plant is a very large one and consists of two sets each of 115 cells. Each cell has a minimum capacity after twelve hours' working of 180 amp. for six hours, with a final voltage of 1.85 volts, and the ampere-hour efficiency is 92.5 per cent. at a minimum. The battery was supplied by the Electric Power Storage Company. There are six 5-ton wharf cranes, of the half portal type, one 2-ton wharf crane on a gantry, and six 30-cwt platform cranes in the goods sheds, all being electrically equipped. All the wheels are fitted with hand traveling gear coupled across so as to insure equal propulsion. This hand gear can be thrown out so as to allow the cranes to be hauled along by power when required. The cranes have lifting and slewing motions worked by two separate motors. For lifting, a Westinghouse traction motor rated at about 40 hp at 300 r.p.m. is used, and for slewing a Westinghouse SB motor of 8 hp at 700 r.p.m. The traction motor is, of course, series wound.

Perhaps the most interesting feature of these cranes is a free

barrel attachment, the lifting barrel not being keyed directly to the shaft, but running loose upon it, being connected or disconnected by a coil clutch. In this way the lifting motor always runs in one direction, and is never reversed. The hand lever actuating the lifting controller also actuates an electric solenoid, which controls the lifting friction coil clutch, the arrangement being such that on moving the lifting handle forward from the off position, current is switched on to the solenoid, the clutch is put into gear, and the lifting motor started simultaneously; after the clutch is in gear, further movement of the lever cuts out resistance and speeds up the motor. There are only two working handles, one for lifting and one for slewing, and there is a treadle for the mechanical brake, so that the braking of the crane is of the simplest order. With this arrangement the motor does not require excessive starting current—in fact, the curve is almost flat.

A no-voltage release forms part of the equipment, so that the lifting drum is held and the controller thrown back should the supply fail for an instant. An over-travel device is also fitted. A brake is further interlocked with the controller, so that current cannot be fed to the motor until the brake is free. The speeds of working are 100 ft. per minute and 400 ft. per minute at the hook for slewing, and double the speed at lift for half the weight can be obtained by unshipping the snatchblock and unslinging the hook at the end of the rope from its eye at the jib head, and so using it for lifting in single purchase. Double reduction gear is employed for the slewing motion. Plug fittings have been placed every 40 ft. to convey current to the cranes, and a round twin 98/20 flexible cable armored with galvanized-iron wire is employed.

The 2-ton crane is of similar design to the six 5-ton cranes, except that it is mounted on a gantry which runs on rails on the same level at 15-ft. centers. This lifts two tons at a radius of 33 ft. at 250 ft. per minute and slews at 400 ft. per minute. The lifting motor is 40-hp Westinghouse traction type motor and a slewing motor of 4 hp.

In addition to the electric cranes, there are ten 1-ton and two 3-ton capstans driven by Westinghouse motors. These capstans are self-contained in cast-iron boxes and cast-iron checker plate covers are fitted on the boxes with hand holes to provide access to the motor bearings. The covers are so made that they can be readily removed. The motors for both the 3-ton and the 1-ton capstans are the same, viz.: 20 hp running at 700 r.p.m., the gearing being treble purchase in the 3-ton capstans and double purchase in the 1-ton capstans, giving a pull of three tons at ¾ mile per hour and one ton at 2½ miles per hour, respectively. The capstan controller

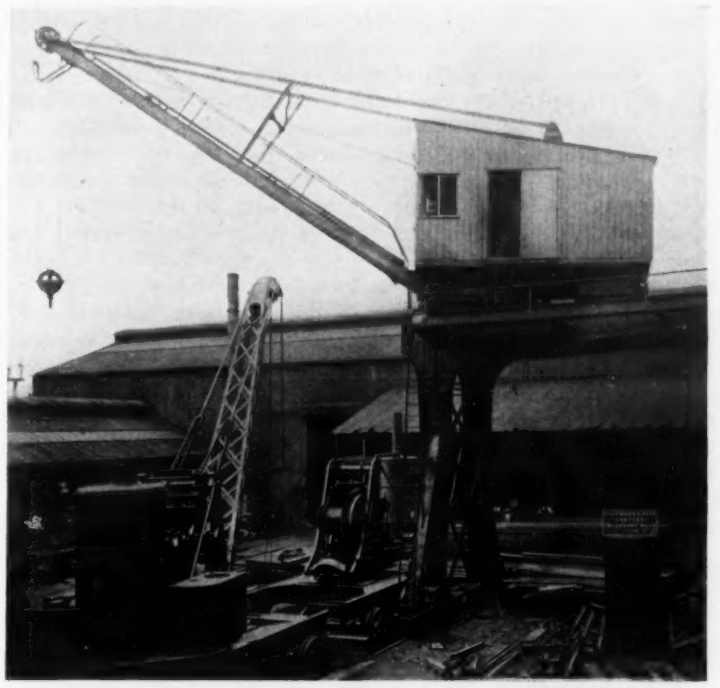


FIG. 4.—ELECTRIC HALF-PORTAL CRANE.

mechanism is actuated by a foot plunger working in a vertical direction, and is provided with overload cut-off and other special safety arrangements. If the overload cut-off goes, the man working the capstan has merely to find what is obstructing the capstan rope, and after the rope is free again depresses the treadle; there is no cut-off for him to replace, and as the cut-off is placed inside the capstan casing he cannot wedge it up or tide it down to save trouble. A magnetic brake drum is provided on the armature shaft of the motor.

Two elevators are provided to take passengers and freight to and from the upper and lower landing stages. The most unusual feature about these is that they are provided with water level cut-offs, so that it is impossible for the lift to come down to the lower level land stage when this is below water. The cars are, moreover, buoyant, so that no accident would happen if they did travel too far down. They are fitted with the usual car switch control, overtravel cut-off, etc., and each is driven by a Westinghouse motor of 20 hp. Lift A carries a load of three tons at 100 ft. per minute and travels 39 ft., whereas lift B travels only 12 ft. 6 in. The lifts are fitted with automatic electric brakes, which come into action automatically when the current is shut off for any reason. The main control switch, together with the motor drum and gearing, consists of an "up" and "down" circuit-breaker operating reversing switches. A special contact carrying carbon tips and placed in the field of a blow-out magnet is provided for breaking the main current. There is also an electrically operated rheostat so arranged that the resistance is gradually cut out as the motor gains speed. Should the e.m.f. fail for any reason the resistance is automatically inserted in series with the armature.

The pumps used about the plant, including those for a water supply service, are all driven electrically. The contract for the whole of the power plant and the building of the power house was carried out by the British Westinghouse Electric & Manufacturing Company, Limited, under the supervision of the Midland Railway Company's chief locomotive engineer, Mr. R. M. Deeley.

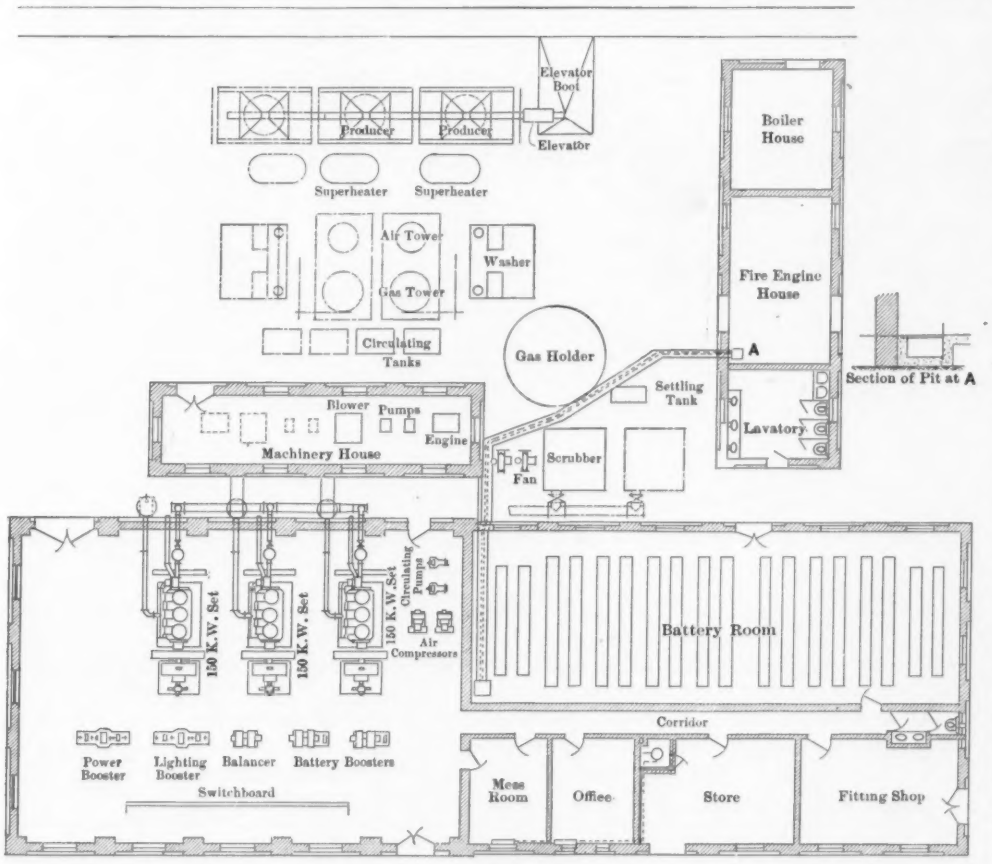


FIG. 3.—PLAN OF POWER PLANT.

The Puyallup River Water Power Development Near Tacoma, Washington.—II.

(*Concluded.*)

SWITCH HOUSE ARRANGEMENT.

FIGS. 13 and 14 show sections through the generator room and switch house. The transformer rooms are at the same level as the generator room; but isolated from the latter by rolling steel doors. On floor No. 2 are the low-tension disconnecting switches, the generator and transformer cables going to the sets of disconnecting switches on either side of the middle partition; the disconnecting switches are installed between the oil switches and the bus, being on the outer walls and immediately below the bus bar compartments, which are above on floor No. 3. In the center of floor No. 3 are the low-tension oil switches, the two oil switches corresponding to a generator or transformer bank being arranged back to back and facing their corresponding set of bus bars. The bus bars are of the laminated type, consisting of flat copper bars with expansion joints and supported on marble slabs set on edge, which in turn rest on concrete slabs forming barriers between adjacent bus bars. The compartments formed by the concrete slabs are to be covered by insulating fireproof doors.

The oil switches are installed in brick cells with soapstone bottom and top slabs and doors. Each pole of a switch is separated from the other poles by brick barriers. The same general scheme is used for both the low and high-tension disconnecting switches and oil switches, except that only one set of high-tension bus bars is at present installed, provision being made for the later installation of the second set. The high-tension disconnecting switches and current transformers are on floor No. 5, while the high-tension oil switches are on floor No. 6. Above floor No. 6 are the two outgoing high-tension line towers, in the north end of which are the high-tension lightning arresters, each pole being separated from its adjacent pole by brick barriers extending the full length of the arrester. The lines emerge from the wire tower centrally through an extra heavy 30-inch sewer tile covered by a glass plate (Fig. 20).

TRANSMISSION LINE.

From the power house two parallel transmission lines run a distance of 22 miles to Bluffs, a station on the line of the Puget Sound Electric Railway, 9 miles from Tacoma and 25 miles from Seattle. From Bluffs one line runs for a great part parallel to the transmission line of the Puget Sound Electric Railway to Seattle and one to Tacoma, also parallel to the transmission line of the Puget Sound Electric Railway.

The transmission line of the Puget Sound Electric Railway is at present operating at 27,000 volts, but the line is designed for operation at double this voltage, so that when it is changed over to a 55,000-volt basis there will be two complete and independent pole lines from the power house to Seattle and Tacoma. At Bluffs there are erected junction pole switches by which the two transmission lines may be cut through independently, one to Seattle and one to Tacoma, or both lines put in multiple, or any section isolated without interfering with the operation of the other sections.

From the power house to Bluffs a private right of way has been secured, the two pole lines being from 50 to 80 feet apart. When passing through wooded sections all dangerous timber has been cleared well back on the land adjacent to the right of way on both sides, so as to completely protect the transmission line.

The minimum length of poles used was 45 feet, with a minimum top diameter of 10½ inches. The standard spacing is 125 feet on straight lines and 90 to 100 feet on curves. The main crossarm is 5 inches x 7 inches x 7 feet 4 inches Washington fir, boiled in raw linseed oil, giving it a much longer life than an untreated arm. This arm is bolted to the pole by two galvanized iron bolts and braced by a combination wood and galvanized iron brace. At the top of the pole is a 5-inch x 7-inch x 18-inch arm supported by an angle iron frame bolted to the pole by two galvanized iron bolts. The main arm supports two insulators, and the top arm one insulator, giving an equilateral triangular spacing of 72 inches between wires.

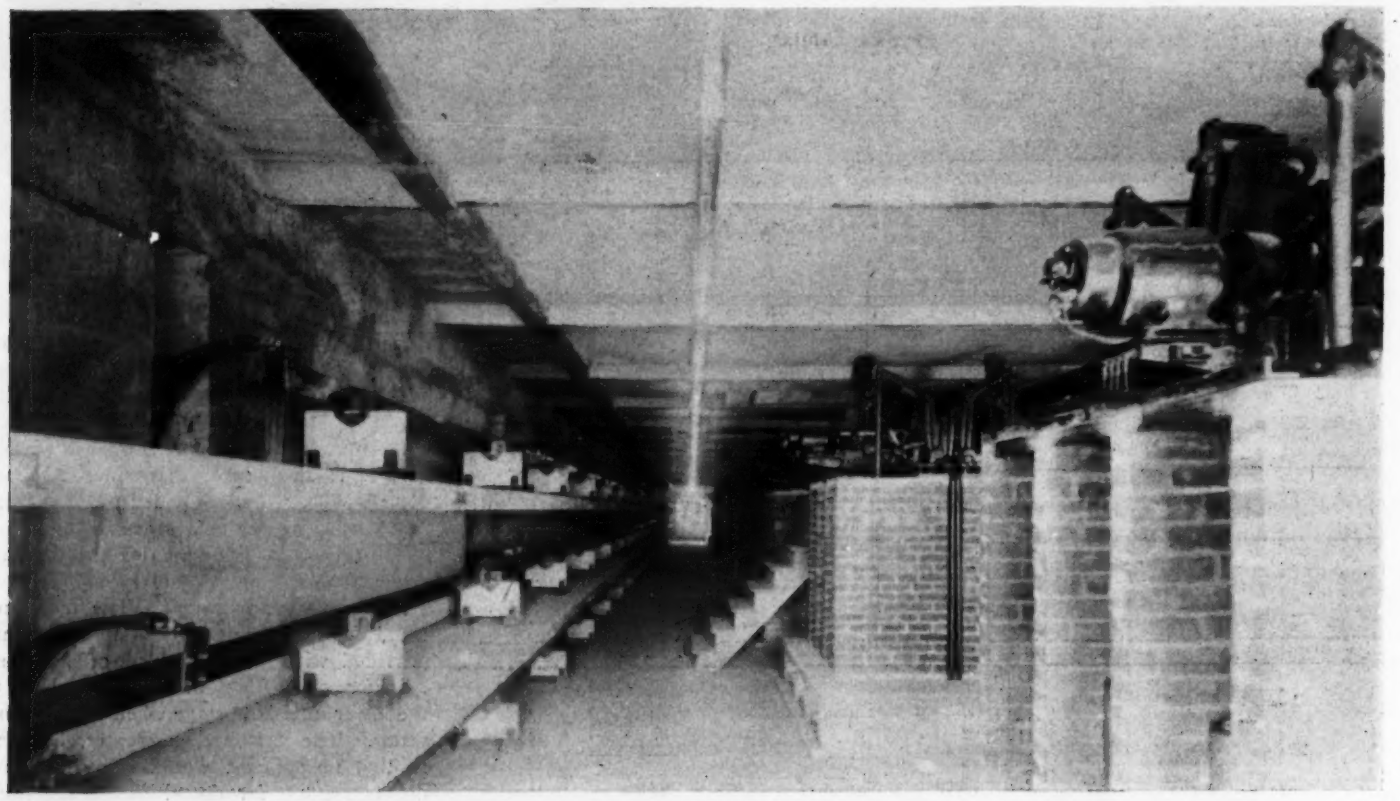


FIG. 12.—VIEW OF THIRD FLOOR SWITCHHOUSE, SHOWING AT LEFT ONE SET 2,300-VOLT BUS BARS WITH CONCRETE BARRIERS, AND AT RIGHT REMOTE-CONTROL GENERATOR AND TRANSFORMER 2,300-VOLT OIL SWITCHES.

The pins on one line from the power house to Bluffs, and from Bluffs to Seattle and Tacoma, are galvanized malleable iron, cast hollow and circular in cross section and having a shank diameter of 2½ inches. The pins on the other line are of the same general exterior form and dimensions, but turned from eucalyptus wood and treated with linseed oil. The iron pins and eucalyptus pins are entirely interchangeable in all parts of the construction.

The insulators are of dark brown glazed porcelain, a portion being furnished by the Locke Insulator Manufacturing Company and a portion by R. Thomas & Sons. The insulators are a special design adopted after tests on a number of samples of varying design. The insulator consists of a broad, umbrella-shaped top 14 inches in diameter, and three inner shells cemented together and to the iron pins by neat Portland cement. They weigh about 22 pounds and stand a potential of 90,000 to 100,000 volts before arcing over under

an artificial rain test. The separate parts of the insulators were given a dry potential test at the factory before shipment, and after assembly in Tacoma and before shipping out on the line they were again tested to a potential corresponding to the dry arcing-over voltage. So far the behavior of these insulators under the weather conditions that have existed since the plant was put into operation and under a line voltage of 55,000 volts, has been entirely satisfactory.

The line wire on both lines from the power house to Bluffs and from Bluffs to Seattle is 19-strand, 4/0 semi-hard drawn rubber cable, and from Bluffs to Tacoma is solid 1/0 semi-hard drawn copper wire. The wires are transposed, making a third of a turn about every four miles. The telephone line is supported on cross-arms seven feet below the main arm and consists of two No. 10 hard drawn copper wires, transposed every tenth pole, the glass insulators being double petticoat deep groove on locust pins. The operation of the telephone line with the above construction has been entirely satisfactory. The company also has an independent telephone line leased from the Sunset Telephone Company and constructed over another route.

SUMNER AND PUYALLUP.

Eighteen miles from the power house and along the transmission line from the power house to Bluffs is the town of Sumner. In Sumner has been built a sub-station to accommodate two 100-kw, 50,000 to 2,300-volt transformers for local power and lighting. At present only one transformer has been installed, furnishing current for lighting Sumner.

A 2,300-volt line will be built from Sumner to Puyallup, a distance of three miles, for supplying the city of Puyallup with current for lighting and power, taking the place of the steam plant at present in operation.

MASSACHUSETTS STREET SUB-STATION.

The receiving station in Seattle is built on Massachusetts Street, near the southerly city limits. Here the high-tension current is

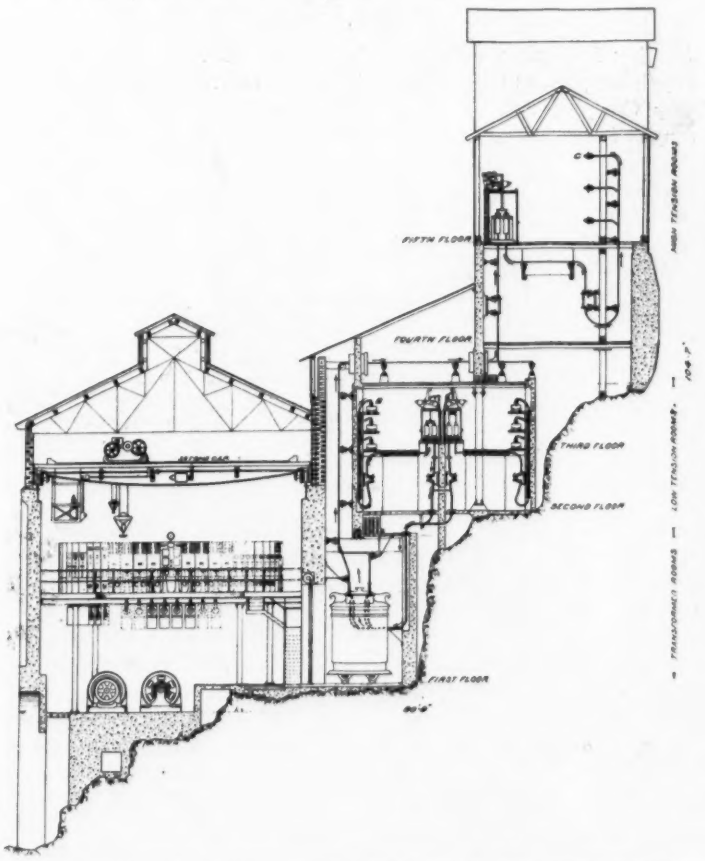


FIG. 13.—SECTION THROUGH GENERATOR ROOM AND SWITCHHOUSE.

stepped down to 2,300 volts for local distribution to the stations of the Seattle Electric Company.

Control is provided for the two incoming high-tension lines by means of high-tension, motor-operated oil switches, and for two 4,000-kw banks of transformers, and for three outgoing 2,300-volt feeders. The control of the transformers consists of a motor-operated, 60,000-volt, 400-amp. oil switch on the high-tension side of each bank of transformers and a motor-operated, 2,500-volt, 4-pole oil switch on the low-tension side of each bank. The control of the 2,300-volt outgoing feeders is by motor-operated, 4-pole oil switches similar to the transformer low-tension switches, differing only in capacity, the former being 800-amp. and the latter 1,200-amp. capacity. All of the oil switches have time limit relays for automatically opening the switches in case of overload or short circuits. There are installed four 2,000-kw transformers in two banks of two each, trans-

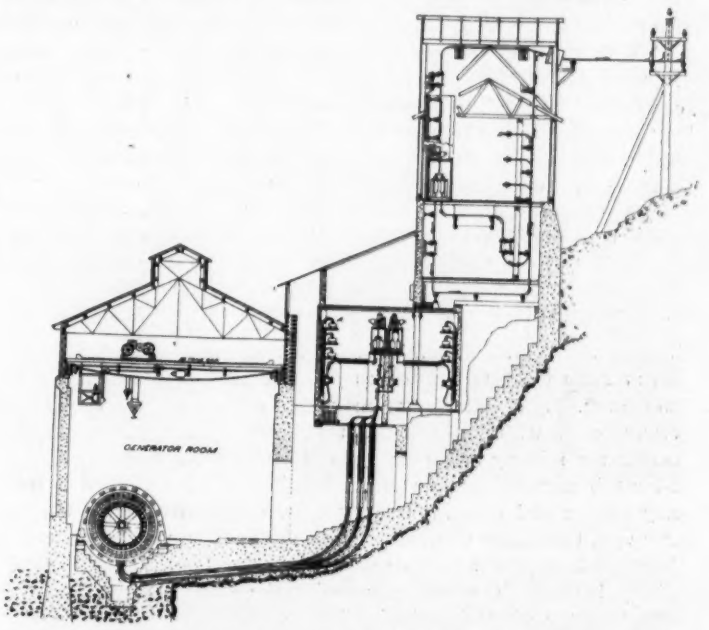


FIG. 14.—SECTION THROUGH GENERATOR ROOM AND SWITCHHOUSE.

forming from 50,000 volts three-phase to 2,300 volts quarter-phase. The arrangement of the windings is such that 50,000, 40,000 and 25,000 volts can be used on the high-tension side, and low-tension voltages of 13,800, 6,900 and 2,300 volts may be obtained. The two transformers constituting a bank are T-connected, but using the full winding in the teazer transformer rather than 87 per cent. as in the usual Scott three-phase-two-phase connection. This produces only 1,900 volts on the low-tension side of the teazer transformer, with 2,300 volts on the main transformer, and in order to boost this

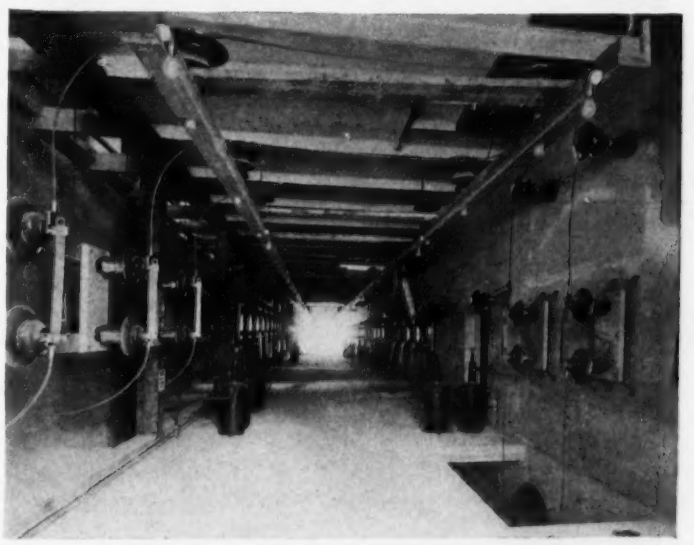


FIG. 15.—VIEW OF FOURTH FLOOR SWITCHHOUSE SHOWING CURRENT TRANSFORMERS FOR INSTRUMENTS; ALSO HIGH-TENSION DISCONNECTING SWITCHES FOR ISOLATING OIL SWITCHES ON FLOOR ABOVE.

to normal a 200-kw transformer called a compensator having the full ampere capacity in the boosting coil of the 2,000-kw transformer and a ratio of transformation of 1,990/310, is installed. This makes it possible to omit all 87 per cent. taps on the high-tension winding, of which there would be a number, for the three primary voltages above stated, and simplifies the transformer construction. All the transformers, including the compensators, are water cooled, the water for cooling being primarily derived from the city service,

but re-cooled by a cooling tower to effect economy by the re-use of water.

There is in addition to the above apparatus two 500-kw transformers in this station with a ratio of transformation of 25,000 to 2,200 volts, installed for connection to the transmission line of the Puget Sound Electric Railway.

For measuring the input of power into the 2,300-volt busses, a graphic recording voltmeter, ammeter and wattmeter are provided, in addition to the integrating wattmeter. Lightning arresters identical with those at the power house are provided for each of the incoming lines. Marble barriers between adjacent poles of the arresters are installed to prevent the traveling of an arc from one leg to another. Four pole static dischargers are installed on the low-tension side of each transformer bank, their purpose being the same as those at the power house. For controlling the voltage of the 2,300-volt outgoing feeders there is installed in each feeder a motor-operated induction regulator each of a capacity of 340 kw. These regulators boost or lower equally each leg of each phase.

SEATTLE ELECTRIC COMPANY'S DISTRIBUTION.

The power is transmitted at 2,200 volts, two-phase, from Massachusetts Street sub-station to Post Street station, and from here also at 2,200 volts, two-phase, to James Street station and Fremont sub-station. Post Street station contains nine 500-kw rotary converters, each with two 300-kw transformers, five giving 500-volt current for railway and four 250-volt current for lighting, also six 50-kw tub transformers for street lighting. This station is a steam relay station and contains two 2,500-kw overload capacity, 60-cycle, 2,200-volt, two-phase alternators, each driven by a vertical compound McIntosh & Seymour engine; also a 1,000-kw lighting and a 500-kw railway battery. The station contains the general switchboard for controlling the whole distribution in Seattle.

James Street station contains two 300-kw induction motor generator sets giving 500-volt railway current. It is also a steam relay station with three 150-kw railway generators driven by a double Corliss engine. When operated on a water power basis the railway generators are used as motors to operate the James Street cable road. Fremont sub-station contains two 300-kw motor generator sets, one induction and one synchronous, the motor end of each being 2,200 volts, two-phase, and the generator end 500 volts, direct current. There is also installed a 300-kw railway battery. The Seattle Electric Company has in addition to the above two steam relay stations not used as sub-stations. These are equipped with direct-current machinery for railway and light and have a combined capacity of 1,500 kw.

TACOMA SUB-STATION.

The receiving station in Tacoma is a new brick building, built adjacent, and as an addition, to the steam station of the Tacoma Railway & Power Company. Control for two incoming high-tension lines is provided as described for Massachusetts Street sub-station. One 4,000-kw 50,000 to 2,300 volts transformer bank is installed with automatic oil switch control on high and low-tension sides.

There are also installed two 500-kw step-up transformers, transforming from 2,300 volts two-phase to 13,800 volts three-phase for supplying power to Fern Hill sub-station, the Northern Pacific Railway Company's shops and other local consumption not within the range of economical distribution at 2,300 volts. Automatic control of this bank is provided on the low-tension side only by means of a type "H," 4-pole, motor-operated oil switch. Spare transformers for each of these banks are provided. For receiving power from the 25,000-volt transmission line of the Puget Sound Electric Railway, four 200-kw, oil-cooled transformers wound for 25,000 to 50,000 volts, stepping down from 25,000 to 2,300 volts, are installed.

The high-tension oil switches are installed on a steel concrete

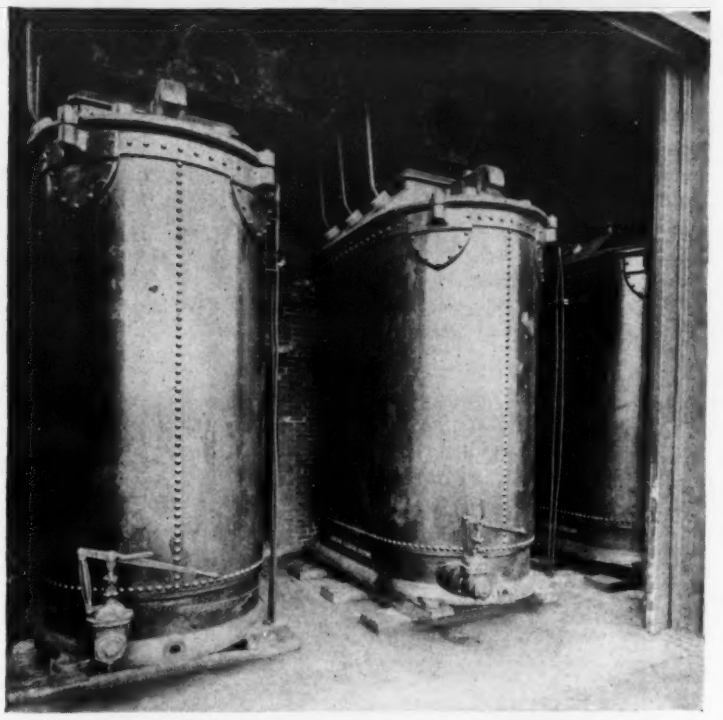


FIG. 23.—2,000-KW TRANSFORMERS, MASSACHUSETTS STREET SUB-STATION, SEATTLE.

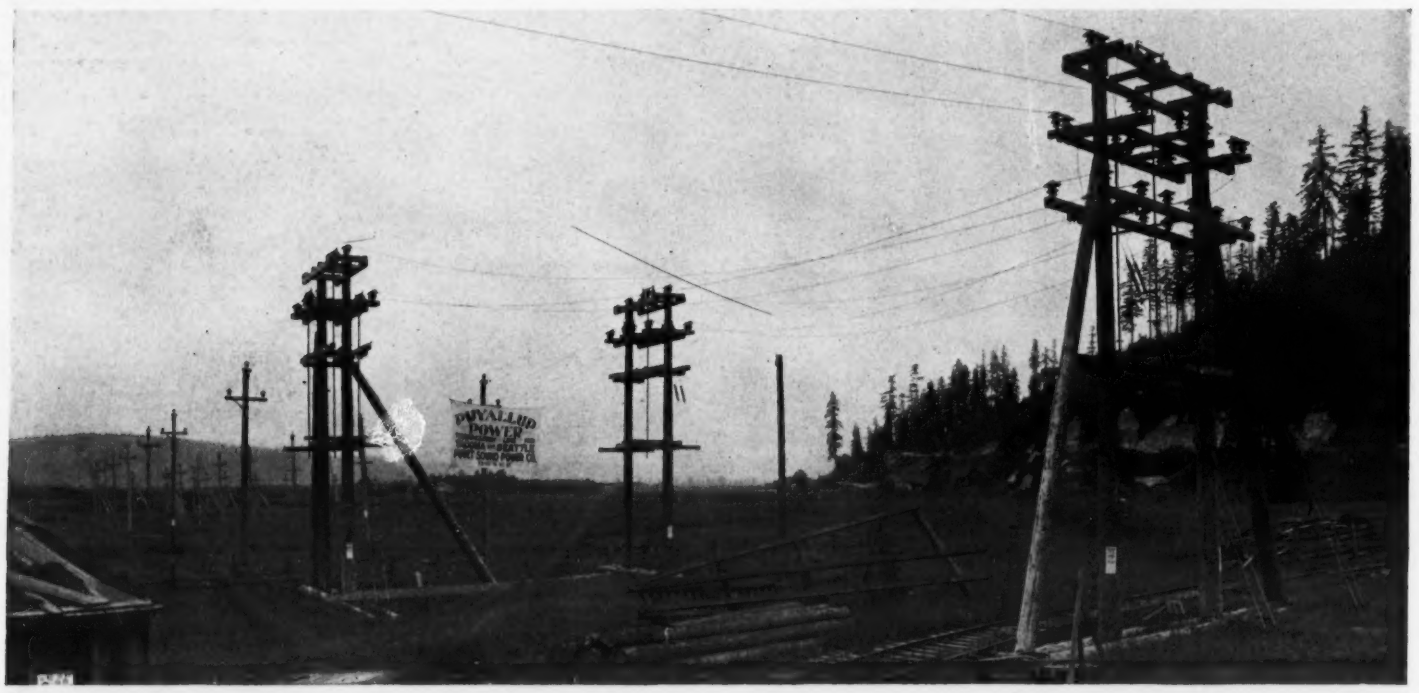


FIG. 22—JUNCTION OF SEATTLE AND TACOMA LINES AT BLUFFS, SHOWING DISCONNECTING SWITCHES.

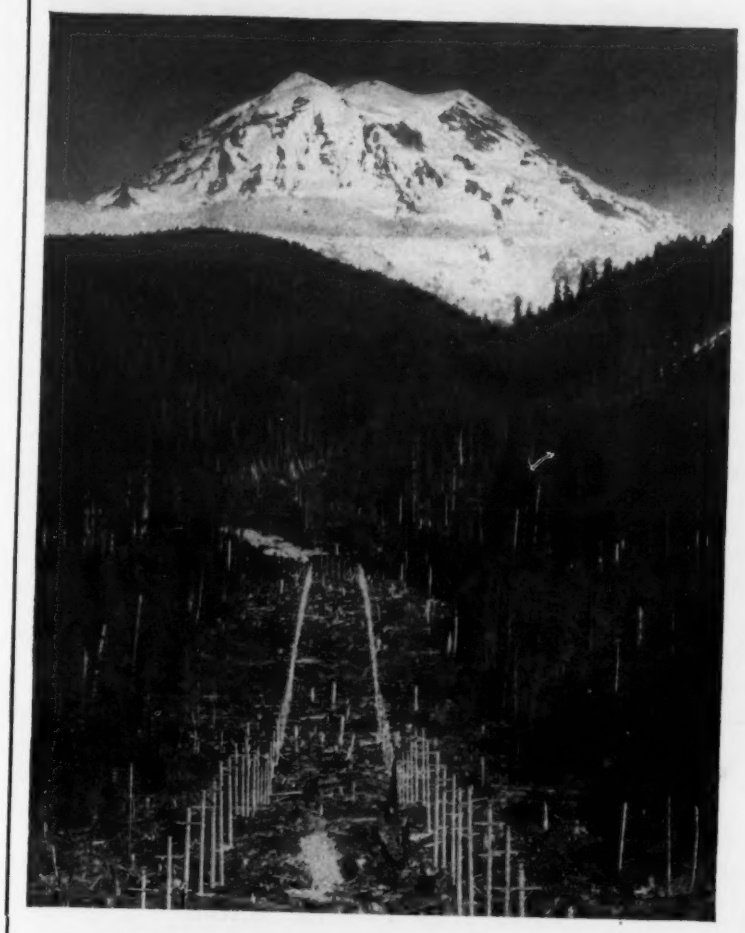


FIG. 16.—VIEW OF TRANSMISSION LINE. MT. RAINIER IN DISTANCE.

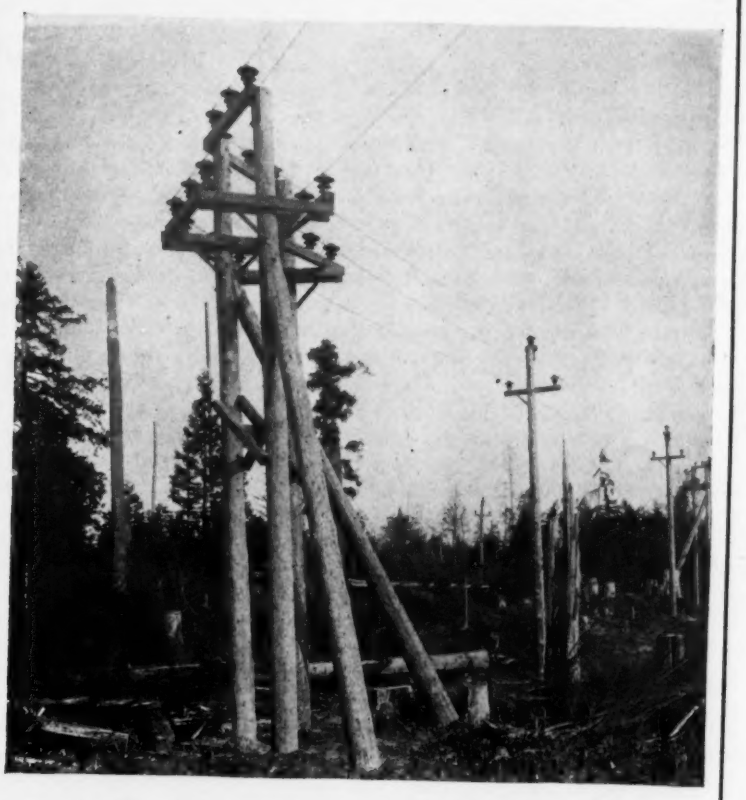


FIG. 19.—STANDARD CURVE CONSTRUCTION ON TRANSMISSION LINE.

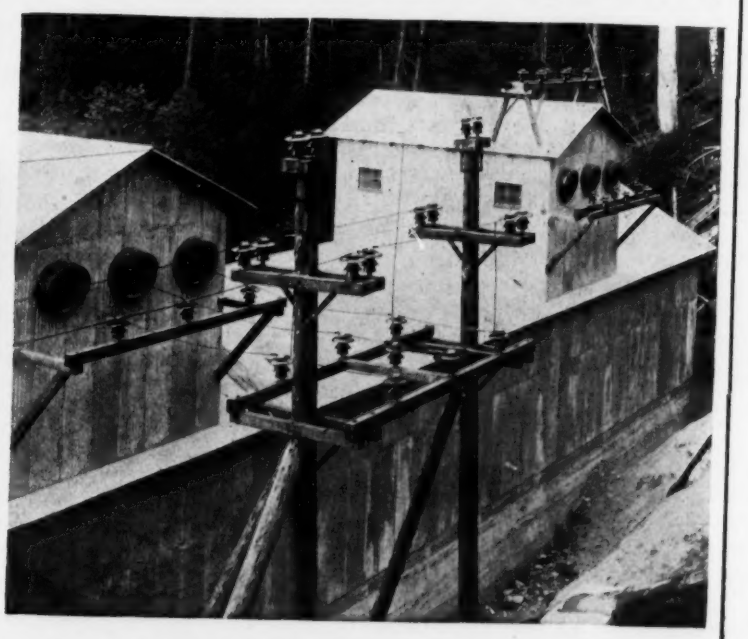


FIG. 20.—TRANSMISSION LINE AT POWER HOUSE.

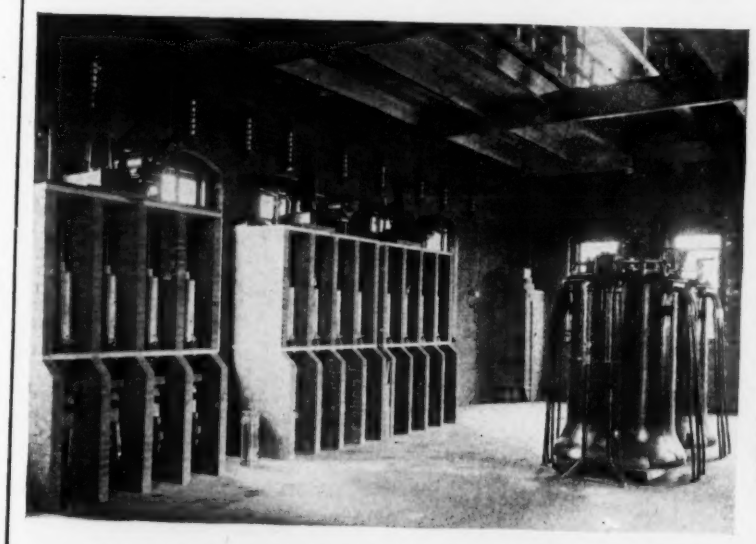


FIG. 17.—MASSACHUSETTS STREET SUB-STATION, SEATTLE.

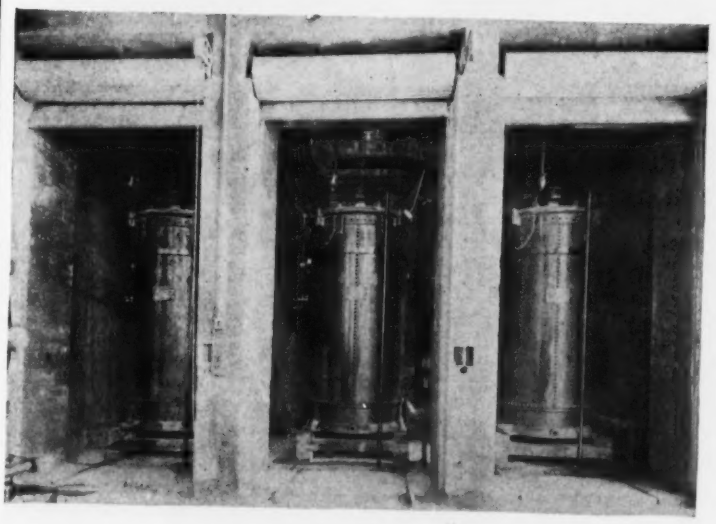


FIG. 18.—TRANSFORMERS.

FIG. 21.—MASSACHUSETTS STREET SUB-STATION, SEATTLE.

gallery 20 feet above the transformer room floor, the two line oil switches on a gallery at right angles to the length of the building and the transformer switch on a gallery parallel to the length and along the north wall of the building. Directly under the transformer oil switch are the transformers themselves. On the opposite side of the room and parallel to its length and four feet above the floor are the transformer 2,300-volt oil switches. One 400-kw induction regulator, similar to those installed in Massachusetts Street sub-station, controls the potential of the supply bus, being installed between the transformer bus and the supply bus. Apparatus for cooling the transformer circulating water is being installed somewhat similar to that at Massachusetts Street sub-station.

The 2,300-volt power is used for lighting and power service in the city of Tacoma partly, and partly converted into 600-volt direct current for railway and commercial motor service. This conversion is effected by two 500-kw induction motor-generator sets, by one 850-kw synchronous motor set, and by 800 kw in belted machines driven by a 1,000-kw synchronous motor. Either this synchronous motor or the 1,000-kw motor driving the 850-kw d. c. generator can be driven by the steam engines which drive on to a line shaft in which these motors are set, being connected at either end by jaw clutches, thus furnishing a supplementary source of supply and reserve for any of the alternating-current distribution, and for the induction motor generator sets supplying current from the railway. A 100-hp induction motor furnishes power for driving a cable road accommodating the hill district of the city.

The Tacoma Railway & Power Company operates about 84 miles of track in the city of Tacoma and between Tacoma and the neighboring towns of Puyallup, Spanaway and Steilacoom, and also furnishes power for the operation of the trains of the Puget Sound Electric Railway within the Tacoma city limits.

At the Fern Hill junction of the Puyallup and Spanaway lines is a steam station of 500-kw capacity. There is being installed in this station a 500-kw synchronous motor generator set, supplied from the sub-station above described by a 13,800-volt transmission line. This same transmission line supplies current for the operation of motors and lights at the shops of the Northern Pacific Railway at South Tacoma and for the operation of induction motors driving air compressors working a Pohle air lift system pumping water for the Tacoma city water supply, near South Tacoma, and for operating a large number of other stationary motors used by various manufacturing concerns.

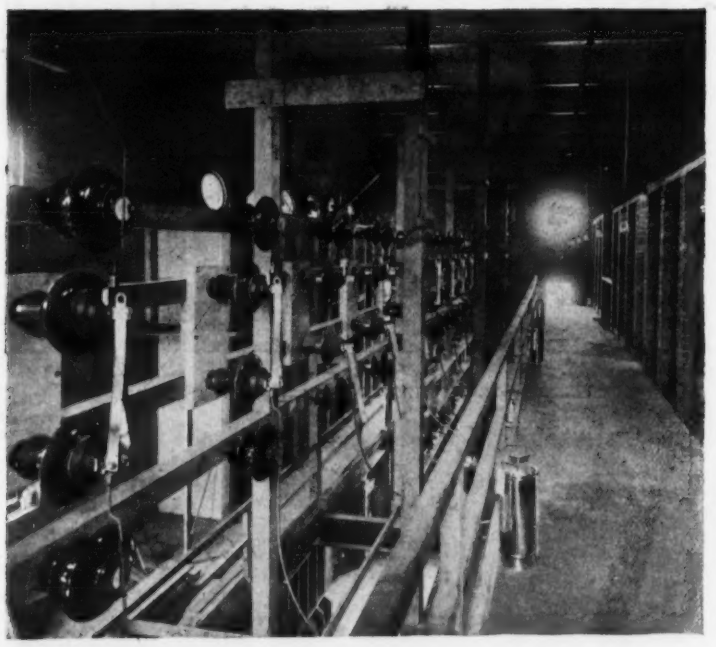


FIG. 24.—HIGH-TENSION WIRING AND DISCONNECTING SWITCHES, MASSACHUSETTS STREET SUB-STATION.

SYSTEM OF PUGET SOUND ELECTRIC RAILWAY.

The Puget Sound Electric Railway operates an interurban third-rail system between Seattle and Tacoma, traversing the White River Valley, a distance of 36 miles, and also a branch line reaching the town of Renton. Six hundred volt direct current is supplied to the third rail through three sub-stations located at Georgetown, Kent and Milton.

Each sub-station contains a bank of transformers stepping down from 25,000 volts three-phase to 2,300 volts two-phase; also a 300-kw induction motor generator set and a storage battery having a rating of 384 kw on the hour basis. Oil switch control is provided on both the high and low-tension sides. From Kent sub-station is operated the city lighting systems of Kent and Auburn, a transformer, separate from those feeding the motor generator set, being provided for supplying this 2,300 volt service.

These sub-stations are supplied from the 25,000-volt transmission line previously mentioned, this line having the 25,000-volt transformer relay at both the Seattle and Tacoma ends. When this line is operated at 50,000 volts, transformers for this voltage will be installed in all the sub-stations.

AUXILIARY AND RELAY APPARATUS.

The electrical development has been designed primarily to insure uniform and uninterrupted service. Continuity of service has been insured by the greatest solidity of construction in every part; by duplicate busses and switches at the power house, duplicate transmission lines and spare transformers at each end of transmission line, so that all repairs can be made without discontinuing service and by having in all the electrical machinery an overload capacity of from 25 per cent. to 50 per cent.

In addition to this there are in reserve in Seattle and Tacoma six steam plants of 10,000 kw aggregate capacity and six storage batteries of 2,700 kw aggregate capacity, all electrically interconnected with each other and with the water power plant, and ready for supplementary and relay service.

Some High Potential Effects.

Last week we referred editorially to the megavolt transformer shown at the World's Fair and below are given some further particulars. The transformer is probably the highest potential low frequency transformer ever constructed. It is of 100 kw capacity on 25 cycles, and it is believed is capable of a potential of 1,000,000 volts. Unfortunately, it has not been possible as yet to run it at its highest potential. The prevailing damp weather at St. Louis since the erection of the transformer makes proper insulation impossible.

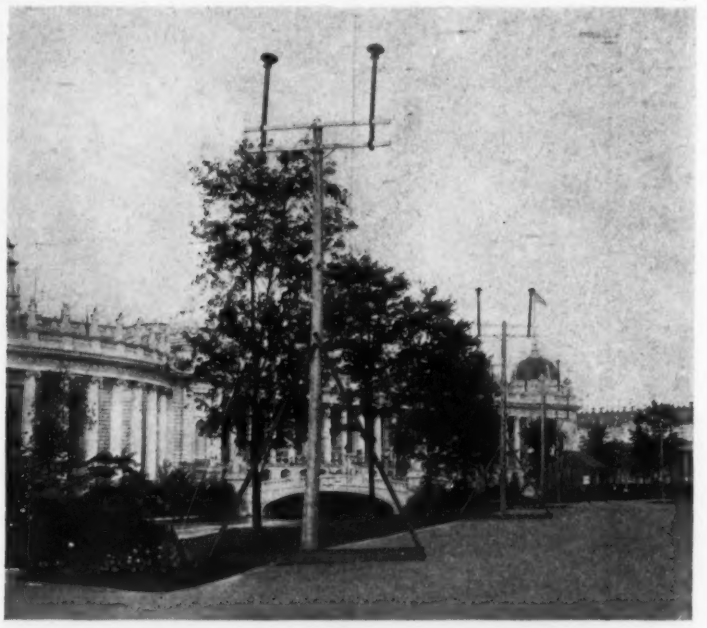


FIG. 1.—POLE LINE AND TRANSFORMER SHED.

The transformer was constructed by C. H. Thordarson, of Chicago. It will ultimately form a part of the experimental apparatus in the research laboratories of Purdue University. It is of the ordinary closed magnetic circuit type, the core and windings being immersed in oil. A special grade and special thickness of silk was used in the insulation of the high potential windings. The dielectric strength of the oil, however, is chiefly depended on for insulation. It is rather remarkable that such an unusual piece of apparatus should be designed and built in a period of twenty-eight days.

The transformer is placed in a small shed built for it, immediately

north of the main entrance to the Palace of Electricity. A specially constructed overhead line leads from the shed in both directions, running the full length of the Palace of Electricity. The method employed in insulating this line is rather novel. Bolted to the cross arms of the poles are sections six feet in length of bituminized conduit furnished by the American Conduit Company. These are capped by 80,000-volt, triple petticoat insulators. Before the experiments are concluded it is hoped to secure by means of this line some interesting effects in brush discharges. Up to the present time this has not been possible because of the breaking down of the insulation before a sufficient voltage has been obtained. The breakdowns usually occur through the timbers of the small shed in which the transformer is placed. It is estimated that these occur at about 400,000 volts.

The demonstrations being made at present consist of discharges between terminals set at a distance apart of from 20 to 24 inches. These terminals placed on the bridge over the lagoon immediately in front of the main entrance to the Palace of Electricity, consist of two 1-inch brass tubes placed vertical, but slightly diverging at the top. The tubes are supported on glass rods about six feet in length.

About 60 to 80 kilowatts are used in making the discharges. These are so vigorous that the accompanying noise can be heard through all the Exposition grounds within a radius of a thousand feet. The discharges are even more vigorous when capacity obtained by the use of the high potential pole line is placed in circuit.

Some photographs obtained of these discharges are very interesting. Those of which reproductions are given herewith were taken at night when the wind was blowing with considerable strength.

Fig. 2 was made with an exposure of one second. It was evidently caught when the wind had died down, as the discharge is steady, not assuming any of the fantastic shapes obtained in other exposures.

Fig. 3 was also obtained with a one second exposure. The discharge first starting across the lower ends of the brass tubes was evidently broken by the wind. A second discharge then occurred higher up on the tubes.

The remaining photographs were made with approximately one-half second exposures.

The discharge in Fig. 4 was likewise broken during the exposure. The effect of the wind in the upper discharge is very evident. The incandescent path has been blown to the right far beyond the tube forming the terminal.

During the exposure of Fig. 5 the wind was evidently blowing very vigorously. The wave effect in separate lines of the discharges most probably represents alternations of the current. Could a photograph be obtained with all these lines showing distinctly the time of the exposure could be readily obtained. As the current was of 25 cycles there should be one of these lines to every one-fiftieth of a second.

Figs. 2, 3, 4, 5 and 6.—Reproductions from Photographs of Discharges.

Meeting of Independent Telephone Association of Southern Indiana.

The fifth annual convention of the Southern Indiana Independent Telephone Association was held at Rockport, Ind., September 26. The attendance was fair and the interest manifested was good. It was the purpose to have an afternoon and an evening session, but owing to the late arrival by boat President Charles D. Knoefel announced to those who had assembled that the regular programme would not be taken up until the night session. Those present enrolled and spent the time looking over displays of supply companies, of which there was a goodly number.

The evening session was taken up with a general discussion of the "Prevailing Needs of Independent Telephone Companies in Southern Indiana." The general trend of the discussion was to the effect that greater harmony should prevail and a wider disposition to bring about a more liberal coöperation in the extension of the service and better toll line service between the local exchanges in Southern Indiana. At the close of the discussion and after the transaction of some miscellaneous business the delegates and visitors were escorted to the city hall where a banquet was held. A. J. Payton, manager of the Home Telephone Company, of Spencer County, was toastmaster, and the following toasts were responded to: "Our Guests," H. J. Cole, Owensboro; "What Shall the Harvest Be?" H. Landgrebe, of Huntingburg; "The German Language on the Telephone," Frank Beaucound, of New Albany; "How Should the Telephone Companies be Managed?" J. L. Arthur, Indianapolis; "The Supply Men," T. M. Thom; "Telephone Finance," C. D. Knoefel, of New Albany. These after-dinner talks were all the received and showed considerable preparation on the part of the speakers. The officers of the association were reëlected as follows: Charles D. Knoefel, New Albany, president; E. W. Landgrebe, Huntingburg, secretary; T. M. Thom, Lamar, treasurer. Owing to the fact that many of the independent companies have been merged and consolidated the attendance the second day was not what was expected and the convention adjourned at noon.

Fast Run in the New York Subway.

A special train on the subway road carrying a party of New York newspaper men on Monday last made the run from the Brooklyn Bridge to Ninety-sixth Street in 10 minutes and 45 seconds, the distance being a little over seven miles. The train attained a speed of 45 miles an hour at several points.

The Interborough Rapid Transit Company, in order to show how near to perfection the operating plant of the company has attained, issued invitations to men in both the editorial and business departments of all the newspapers in New York to come and see for themselves. E. P. Bryan, vice-president, represented the company as host, and he and Mr. Hedley, the general manager, accompanied the train. The time and place for starting were 2.30 in the afternoon, at the City Hall Station. There was some little delay in getting away, and it was not until seven minutes later that the train had swung around the loop under the Post Office and reached the great underground chamber which is to connect the subway with the bridge.

Here it was that the start northward was made. It had been hinted before leaving the City Hall that the train would make a record run. There was an official timekeeper on the front platform, with a stop watch. There were no stops made in the run, or so much ground never could have been covered in so short a time. It was one swift rush from the time the train got its full momentum until it began to slacken as it approached its destination. Naturally, however, there were slowdowns for the curves.

The train was a standard one, such as will be used at hours of the day when the travel is heaviest. The forward and rear cars were of the steel type, with interior fittings in aluminum. They were particularly bright and cheerful. The others were of the type—copper sheathed—which has long been familiar on the Second Avenue elevated road.

At Ninety-sixth Street there was a stop and then the train made another swift rush for One Hundred and Forty-fifth Street, reaching there in 5¼ minutes. This made the total run from the bridge to One Hundred and Forty-fifth Street, including one stop, just 16 minutes. On the return trip the train was switched at Ninety-sixth Street over to the Lenox Avenue line and again went to One Hundred and Forty-fifth Street.

Some Early Electric Railway Generators.

BY A. L. ROHRER.

THE Thomson-Houston Electric Company had its first experience in building electric railway apparatus in that which it supplied the Bentley-Knight Railway Company in 1887. The first installation where the T-H apparatus was used was at Woonsocket, Rhode Island, in July of that year.

This railway was at that time about five miles long, and was a combination of several ordinary horse cars and one electric. About three-quarters of a mile of double overhead trolley wire was installed to try out the latter, and on this part of the line there were numerous curves and grades, the latter reaching as much as 6½ to 7 per cent. The car was equipped with one double-reduction motor rated then at 15 hp, but which had a capacity of 30 hp as now rated. In the preliminary run it was fitted with flat copper brushes, such as were used on the Thomson arc dynamo, and afterwards with radial brushes built up of copper laminae. The weight of truck and motor was about 4,000 pounds.

The power for operating this car was supplied by the Woonsocket Electric Machine & Power Company from its station, where were located two 400-volt Thomson inclined-coil, compound-wound dynamos, which were completed and tested at the Lynn Works the latter part of June, 1887, and were shipped July 8 and July 15 to Woonsocket. These machines were classed as H-I (Fig. 1). This type of generator was well known at that time, as it was largely used

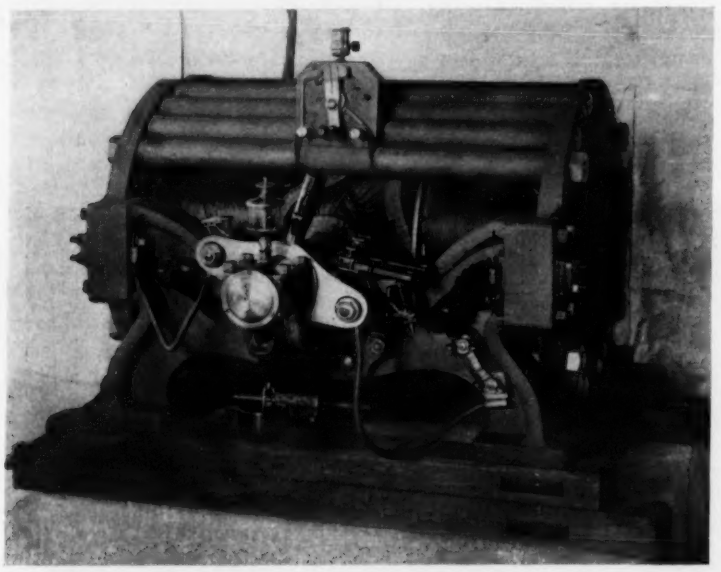


FIG. 1.—THOMSON INCLINED COIL, COMPOUND-WOUND DYNAMO.

for both arc and incandescent lighting, and its spherical armature and cup-shaped field magnets were its novel features.

The capacity of each generator at Woonsocket was 100 amperes at 400 volts and 1,150 r.p.m. The armature was wound with one No. 6 B. & S. continuous wire, and, as a 64-segment commutator was used, there were 64 commutator leading-in wires carried along the shaft and through an opening in the sheet-iron core to the periphery of the armature, where they were soldered to the winding in such a way that there were three turns per segment. This opening in the core also allowed some ventilation, and the 72 pounds of wires on the armature gave the required output with very good behavior at the commutator, using copper brushes, of course.

Another novel feature of this generator was that no external field rheostat was needed, as each field had 40 turns of German silver wire wound on it, and this wire was connected to sliding contacts on the top so that there were 20 contacts on each generator for cutting in or out resistance.

Four of these H-I generators were shipped to the Bentley-Knight Railway Company in October and November, 1887, for the Observatory Hill Passenger Railway Company, Allegheny, Pa., which road was started in January, 1888. These particular machines were, however, wound for 250 volts as ordered, and two were connected in series for 500 volts.

We might relate one experience with the series or inclined coils on these generators. The short circuits on the overhead trolley portion of the road were rather frequent and severe, so much so that the coils or "horse collars," as they were called, were pulled down against the armature, and it was necessary to make their supports more secure by lashing them to the encircling bars of the magnet frame.

By changing the armature winding on the Woonsocket design, so as to have four turns per segment, the generator became the regular 500-volt machine, and the first one with this change was used to furnish power for operating the Revere Beach Railway on July 4, 1888. This was the first railway installed by the T-H Company.

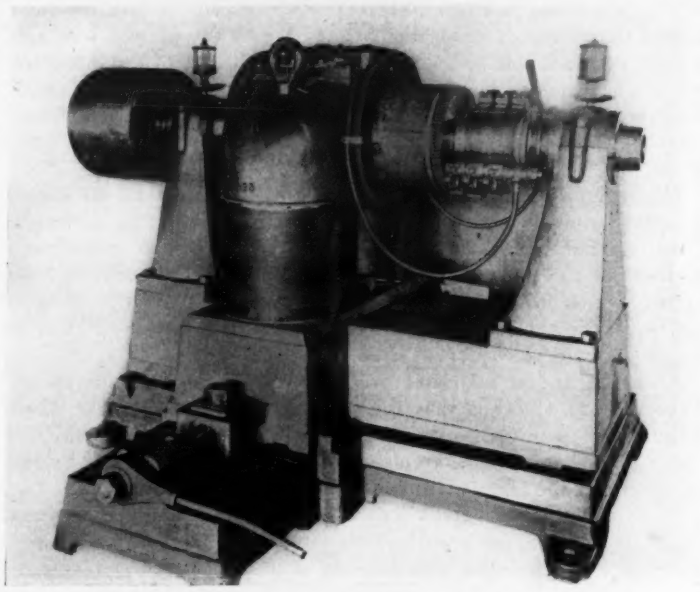


FIG. 2.—T.-H. BIPOLAR MACHINE.

During 1887 and 1888 the T-H Company developed a full line of bipolar machines, which were used for both motors and generators. When it was decided in March, 1888, to purchase the Van Depoele Electric Company and enter the electric railway field actively, it was realized that the H-I generator was of too small capacity for the future and the largest of the bipolars was selected as the proper-sized unit. This machine was first classed as No. 25-S S and afterwards as the D-62 or 80-hp generator, as it was referred to at that time (Figs. 2 and 3).

The first of these machines wound for 500 volts was shipped on July 23, 1888, and was installed in the station of the North Shore Electric Company, where it was run in multiple with the H-I machine previously shipped, and supplied power for the Revere Beach Railway.

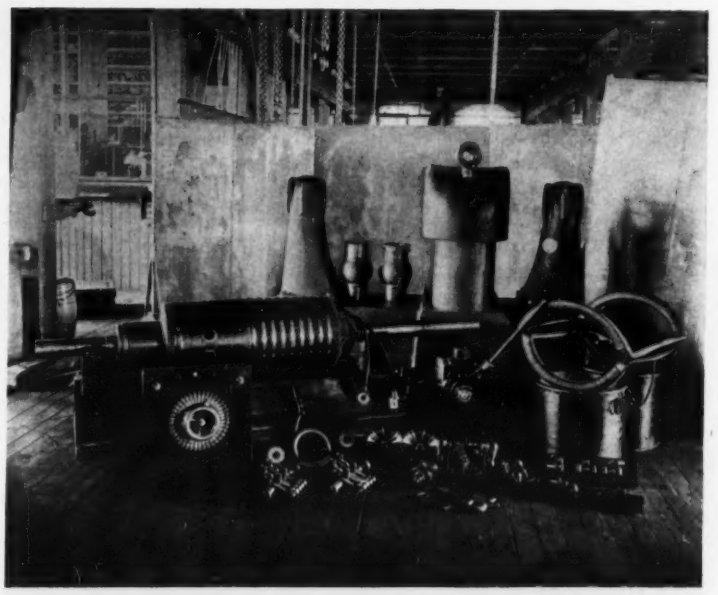


FIG. 3.—PARTS OF BIPOLAR MACHINE DISASSEMBLED.

This bipolar machine was a very satisfactory 500-volt generator, and the records show that during the following fifteen months more

than 100 were shipped. The commutator had 90 segments, the armature having two turns of four .102 wires per segment. The series coils of the first machines were of the "horse collar" style, and were placed directly around the armature. Under heavy overload the copper brushes required considerable movement, but when the car-

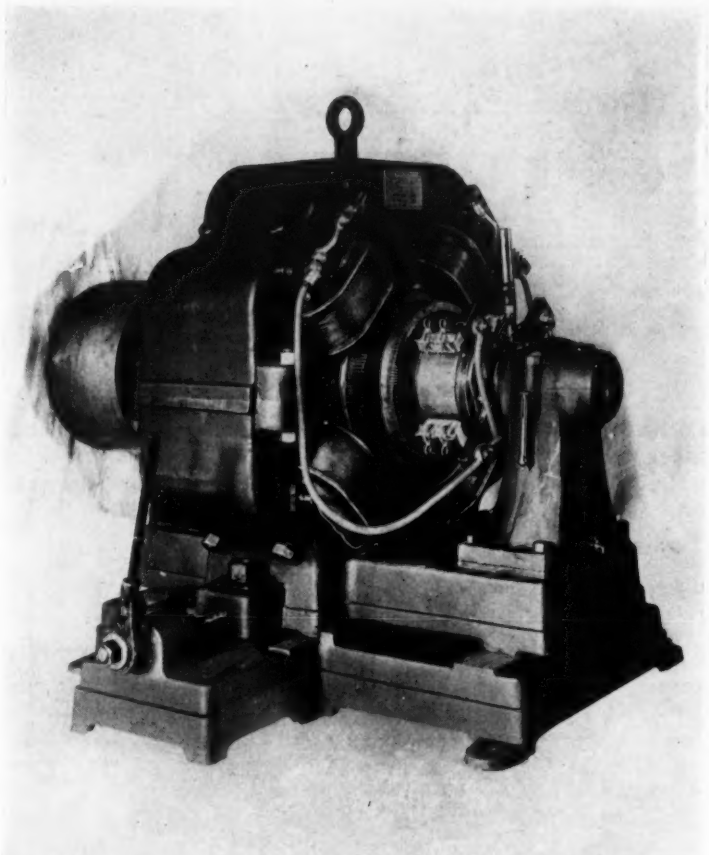


FIG. 4.—FOUR-POLE MACHINE.

bon brush was suggested by Van Depoele and applied to these machines, the yoke could be fixed in one position and the commutator would take on a good glaze. The carbon brush came as a great boon to both the operating man and the designing engineer. In the latter part of 1888 numerous inquiries were made for generators for other kinds of work and brought forth varying requirements,

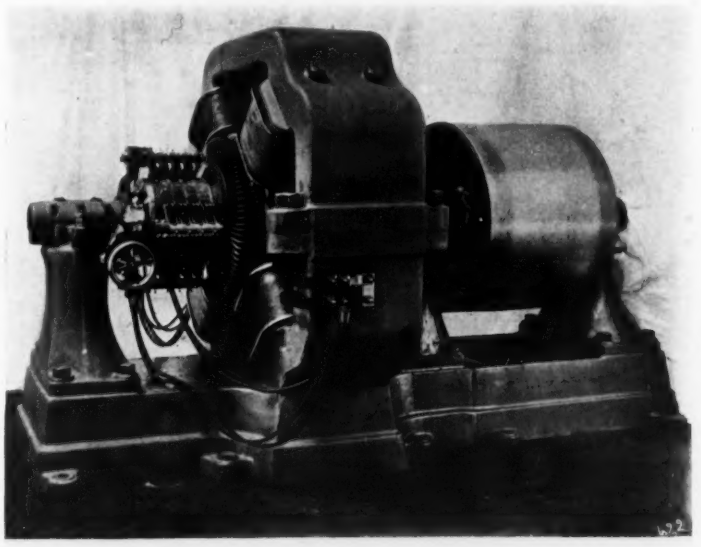


FIG. 5.—GRAMME RING, FOUR-POLE MACHINE.

some of which the engineers of the T-H Company thought could be best met by four-pole machines the design of which was then started. The first ones built were of small capacity and were supplied the United States Navy and were installed in 1889 on the U. S. S. Petrel and the U. S. S. Vesuvius. These were of the Gramme ring type. When the demand came for 100-hp generators for railway work, it was decided to design a four-pole machine which was known as the M P-75 (Fig. 4), the armature of which embodied some of the mechanical features of the Van Depoele generator of the same capacity. The first M P-75 was completed and shipped in October, 1889, to the Lynn Gas & Electric Company, and in December two were shipped to the Boston West End Street Railway and installed in its temporary power house on Albany Street. The first seven or eight machines had 120-segment commutators and were not very satisfactory generators. The next lot had 180-segment commutators and self-oiling bearings; the first of this lot was shipped to St. Louis in September, 1890. There were in all 115 of these machines built.

In 1891 a toothed or iron-clad armature was built for this machine and its capacity increased so that it became the M P-90 and the first of the redesigned machines was shipped in August, 1891, to the West End Street Railway.

When the West End Street Railway decided to electrify practically its whole system in Boston and placed its famous order for 600 motors with the T.-H. Company, on June 27, 1889, its engineers gave much study to the power house problem, and they decided first on generators of 250 hp capacity. On August 9, 1889, the T-H Company made a proposition for furnishing six 250-hp generators, which was accepted and a provisional order for two more was placed, making eight in all. Until these generators could be delivered the T-H Company was to supply smaller ones, so that in April, 18991, the West End Railway had in its several power stations 47 80-hp and 3 100-hp generators, the largest number being at the Hinckley Locomotive Works.

The T-H Company then started the design of an MP-200 Gramme ring four-pole type in July 1889 (Fig. 5), the general data being as follows:

Bore of fields, 40 inches; diameter of armature core, 37½ inches; diameter of commutator, 20 inches; number of segments, 180; depth of segments, 2⅛ inches; mica insulation, 1-16 inch; armature punching, 6 inches wide, 6 to a circle and punched from .014 iron; bore of armature spider, 6 inches; bore of commutator spider, 5¾ inches; bearings, 4½ inches by 18 inches; speed, 400 r.p.m.

The first machine was completed in May, 1890, and on account of the fact that the Thomson-Houston Co. had no engine of sufficient capacity to test this generator, it was erected in the shop of the Thomson Electric Welding Company, where later on it was tested and found to be up to its rated capacity with what was then considered low temperatures. This machine was then transferred to a new building which the Thomson-Houston Co. had just completed and where a 440-hp testing engine had been installed, and the generator was used for several weeks to supply the Lynn & Boston Railway Company with power for operating its cars. The armature was then modified to the extent of providing the core with four ventilating ducts and arranging the winding inside the core so as to

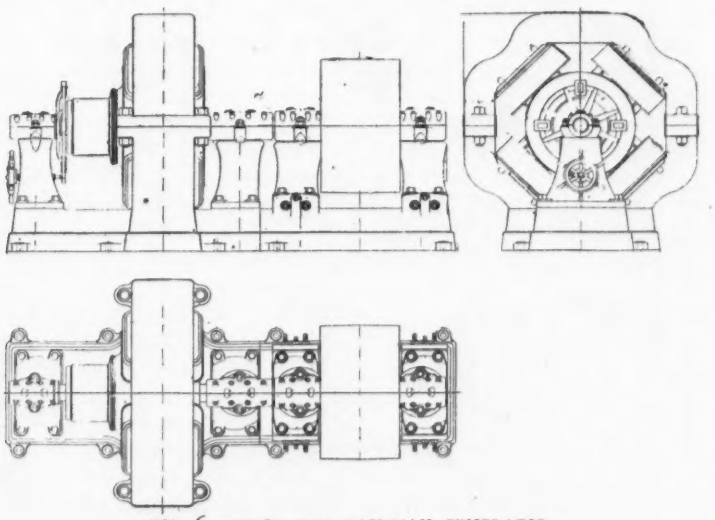


FIG. 6.—WEST END RAILWAY GENERATOR.

ventilate it. When tested it was found possible to increase the rating to 270 kw and thereafter it was known as the MP-270, and some 35 of them were shipped.

Meanwhile the West End Street Railway Company was enlarging its system and its engineers found that 250-hp generators would be too small a unit and decided on a 400-hp unit. After several confer-

ences with the engineers of the Thomson-Houston Co., a generator was fixed upon of 360 kw with such an overload capacity as really to call for a 500-kw generator of ordinary rating. The order for 250-hp generators was changed the latter part of 1890, at which time the design of the MP-500 was started.

This generator is of the iron-clad or toothed armature type, and

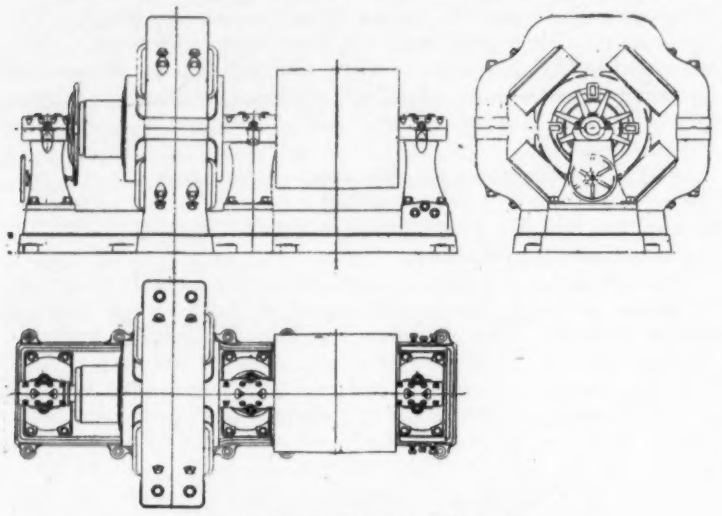


FIG. 7.—THREE-BEARING GENERATOR.

as 68 machines of this size were built, they were pretty well known. It might be well, however, to state that as the generator was designed for the West End Railway, all for that order had four bearings with a clutch and quill attachment and pulley to fit the particular drive of their power stations (Fig. 6). The others had three bearings 5¾ inches by 18 inches and 6 inches by 24 inches, with a 49-inch by 49-inch pulley (Fig. 7).

In 1891 the Thomson-Houston Company anticipated a demand for direct-connected generators for railway work and started the design of an MP-6-250-90 (Fig. 8). This generator was completed in 1892 and shipped to Providence, R. I.

This was immediately followed by the design of an MP-6-200-150 (Fig. 9), which was shipped to the World's Fair, being driven by a McIntosh & Seymour tandem-compound engine, and used to furnish energy for the Intramural Railway. A duplicate was shipped about

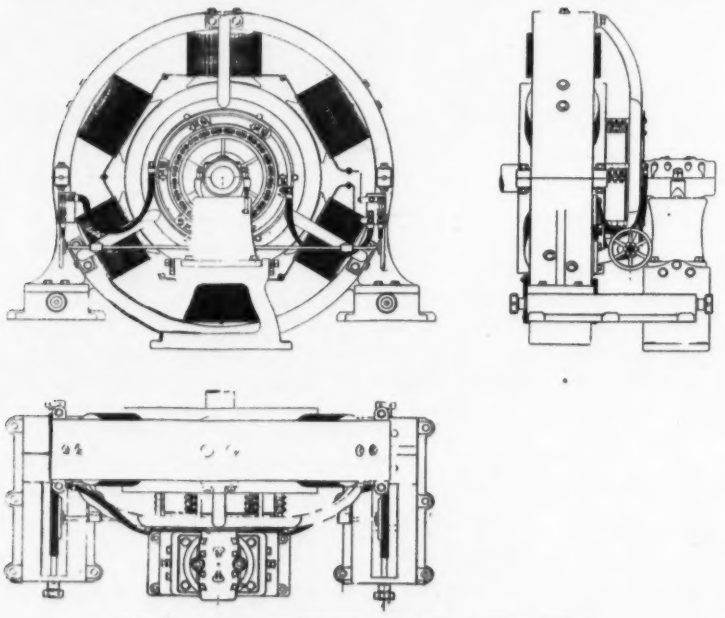


FIG. 8.—DIRECT-CONNECTED RAILWAY GENERATOR.

the same time to the Cass Avenue Railway, St. Louis. An MP-10-400-100 (Fig. 10) was designed about the same time and was also shipped to the World's Fair and connected to an Allis tandem compound engine in the Intramural power house.

The tests on these three generators led to the design in 1892 of two larger ones, the MP-10-750-100 (Fig. 11) and the MP-12-1,500-75 (Fig. 12), both of which were built and shipped to the World's Fair and installed in the Intramural power house.

The 750-kw machine was driven by a Lake Erie vertical cross-compound engine, and the 1,500-kw was driven by an Allis cross-compound engine. On account of the size of the parts and difficulties

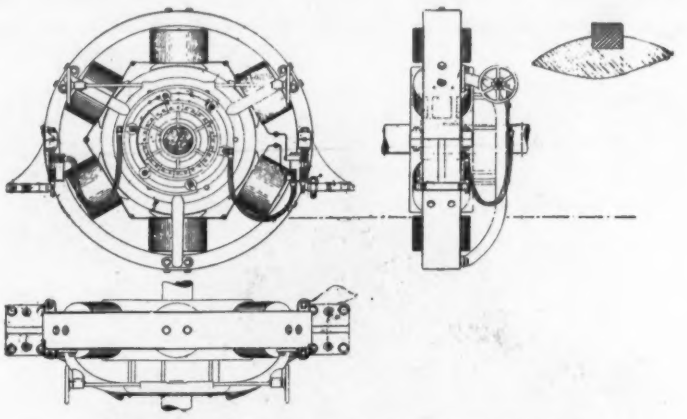


FIG. 9.—DIRECT-CONNECTED RAILWAY GENERATOR.

of transportation, the armature was assembled and wound in the power station.

Meanwhile the Edison Company, which had at first used the well-

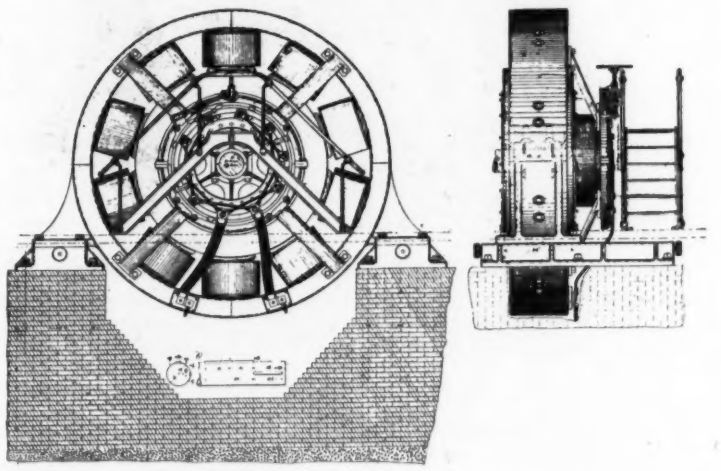


FIG. 10.—DIRECT-CONNECTED RAILWAY GENERATOR.

known bipolar Edison type of generators for railway work, found it necessary to develop a direct-connected generator for railway work,

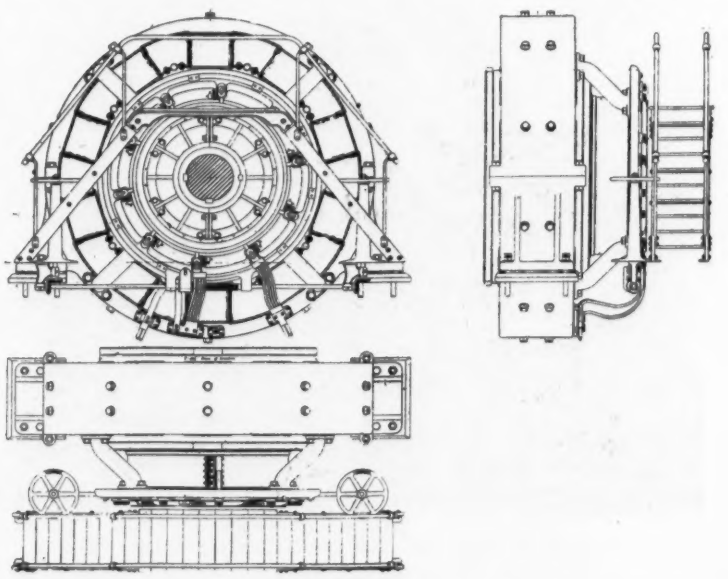


FIG. 11.—RAILWAY GENERATOR OF 1892.

and with the experience gained with a similar machine for 125 volts, it designed in 1891 and 1892 an MP-6-200-120, the armature of which was of the Gramme ring type with face commutator and copper

brushes. Several of these machines were built and shipped to Milwaukee.

The experience gained by both companies has, since their consoli-

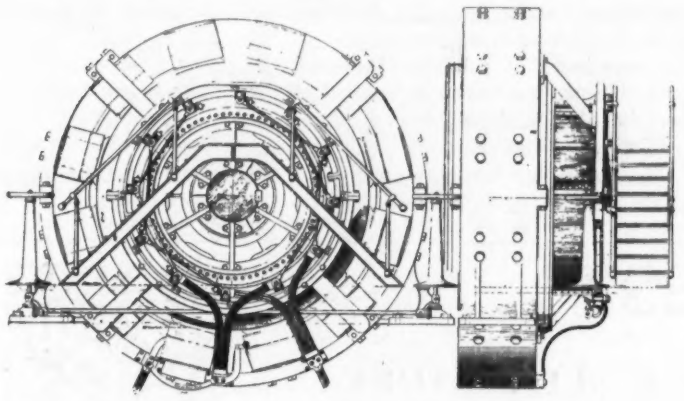


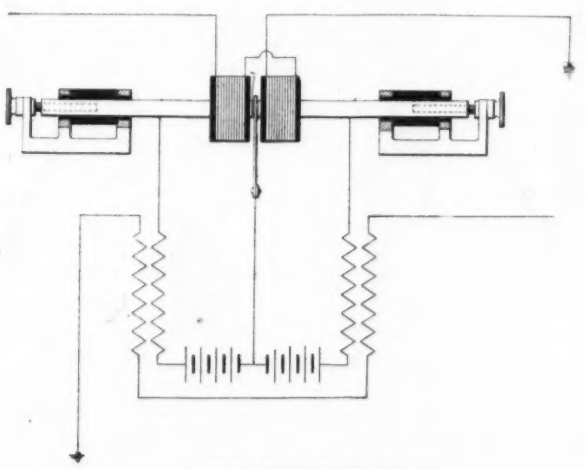
FIG. 12.—RAILWAY GENERATOR OF 1892.

dation into the General Electric Company, developed the line of lighting and railway generators which have been produced in the last twelve years.

New Telephone Patents.

TELEPHONE REPEATER.

The telephone repeater has again bobbed up, this time in the form shown in Fig. 1, which repeater has been invented and patented by I. Kitsee, of Philadelphia. This is a novel arrangement of the oft-tried telephone microphone form. As will be noted the repeating circuit is carried through two granular buttons, whose microphonic contacts are varied by direct contact with the movable polar-



KITSEE TELEPHONE RELAY.

ized armature. The coils of the various induction and receiving coils are properly poled to assist each other in final effect. Mr. Kitsee has assigned his patent to the Keystone State Telephone & Telegraph Company.

AUTOMATIC RINGING KEY.

In some quarters there is a demand for a ringing key which, upon once being depressed, will maintain the ringing circuits for a predetermined period, and then self restore. The control of such a key has been accomplished heretofore either by a thermal device or by supplying ringing current to the key, broken up into impulses of the desired length. In the present key the control is pneumatic, the restoring of the key being accomplished by the piston of a dash pot. The time required for a stroke of this piston may be controlled by regulations of the air vents of the dash pot. When the key is set, the key plunger overtravels, being slowly restored by the dash pot piston spring, until near the end of its stroke, at which point the cam faces of the switch springs snap the plunger home. L. M. Ericsson has patented this key and has assigned his patent to A. L. M. Ericsson & Co., of Stockholm, Sweden.

CURRENT NEWS AND NOTES.

A NOVEL TELEGRAPH KEY.—A patent granted September 27, to John Beard, describes a singular telegraphic manual transmitting device. This consists of a plate with a surface consisting alternately of metallic and insulating strips, and a roller stylus held in the hand. If the roller is passed at an even speed over the surface, a succession of dots will be transmitted; and if it is passed at a lower speed over one of the strips or segments, a dash will be transmitted.

WIRELESS ON COAST OF FRANCE.—The Government of France will install a wireless telegraph station on an island off the coast. This will be used to communicate with incoming and outgoing transatlantic steamships. The War Department is also extending the use of wireless telegraphy. Experiments made a couple of weeks ago at the Eiffel Tower permitted the army officials in Paris to carry on wireless communication with Dijon, two hundred miles distant.

COMMUNICATIONS IN DISCUSSION OF CONGRESS PAPERS.—We are informed that written communications by way of discussion from Congress members upon any Congress papers will be received by the general secretary of the Congress, Dr. A. E. Kennelly, Harvard University, Cambridge, Mass., up to October 15. Those desiring to submit communications who do not have a copy of the paper or papers they wish to discuss may receive the same by applying to Mr. H. H. Humphrey, Electrical Engineer, Chemical Building, St. Louis, Mo. Mr. Humphrey has kindly promised to furnish papers on application until the 10th of October.

ELECTRICITY IN ITALY.—The Italian ministry of posts and telegraphs has received authority from Parliament to establish telephonic connections between Brescia and Bergamo; Lecco and Bergamo; Cremona and Piacenza; Genoa, Pisa and Leghorn; Naples, Foggia and Barletta; Naples, Reggio, Calabria and Messina. The authorities of the province of Rome propose to build an electric railroad between the city of Rome and Civita Castellana. The city council of Venice has decided to purchase a number of electric launches for use on the canals of that city. The general inspector of the Adriatic Railroad, whose office is in Rome, has received permission to purchase 150 electric accumulators. The Adriatic Railroad Company is planning to build an electric road from Chiasso to Como and Chiavenna.

MULTIPLE-RATE METER.—One of the earlier advocates of multiple-rate metering was Mr. Gisbert Kapp, and as early as 1892 he patented a meter to meet the requirements of a differential tariff. An American patent issued September 27 to Mr. Kapp relates to details of methods to carry out the earlier invention. The application for the patent was filed in 1897, and the claims allowed are quite broad, the first claim reading "The combination with an electric meter apparatus, of means for changing the speed or rate of operation of the same for different hours of the day." The specifications describe means for changing either the speed of registry or the flow of current in an operative portion of the meter, for different hours of the day. For these purposes purely mechanical means, or electrical in combination with mechanical means, are described.

FROZEN WATER PIPES.—Mr. Dudley Farrand, secretary of the National Electric Light Association, writes us as follows: "In accordance with the suggestion of President Edgar at the Boston meeting of the National Electric Association, an investigation of methods in use for the thawing of frozen water pipes by electricity is now being made for the benefit of members. Mr. George S. Haley, of Rutland, Vt., has been appointed by President Davis as a committee to report on this subject, and Mr. Haley has the work already well under way, with a view of publishing results before freezing weather sets in. Mr. Haley contributed a very full and instructive article on this subject to the 'Wrinkle' department of the Boston convention, having had considerable experience of his own in the use of electricity for this purpose; and his report, including the experience of companies under different conditions, will be looked for with interest by members located in the zone of severe frost."

LETTER TO THE EDITORS.

To the Editors of Electrical World and Engineer:

SIRS:—On the Pawcatuck Valley Street Railway there recently occurred a trouble of a kind that in all my experience I had never previously encountered. When that system was taken over we carefully inspected the overhead line work, and put in new insulators to replace any that leaked badly. We finally got the line in condition so that there was practically no leak. About a week ago our superintendent, Mr. Webber, was called upon to repair a bad break in the trolley line. The break occurred about 11 o'clock at night, and four or five hundred feet of the trolley wire and bracket arms came down. In going over the brackets it was found that the three lag screws that bolted the bracket to the pole were eaten entirely away where they entered the pole. Of course, the explanation is that electrolytic action of the escaping current caused the damage. These lag screws were so corroded that there was not enough of them left to hold the bracket on the pole.

I have heard of individual brackets falling, but I never yet heard of such a number falling at once. I should like to know if you have ever heard of a similar case.

WESTERLY, R. I. GEO. W. MANSFIELD.

[Mr. Mansfield has sent us one of the lag screws, substantiating his statements.—EDS. E. W. and E.]

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Series Transformer.—WILDER.—An illustrated article on the characteristic features of the operation of a series transformer. When the secondary coil is open, the iron of the transformer is worked at a high degree of saturation which gives an abnormally large secondary voltage. In the case of a 10 to ½-ampere transformer the secondary voltage was approximately 4,000 volts on open circuit. This is the reason why the series transformer should never have its secondary open when current is flowing in the primary. To cause the ratio of the primary to the secondary current to be as nearly constant as possible, the iron must be worked at a low magnetic density so that very little magnetizing force is required. The series transformer is worked out about one-tenth the magnetic density of the shunt transformer. For this reason an ordinary shunt transformer would not be suitable for use as a series transformer. The fact that the current ratio is not appreciably affected by changes, within limits, in the secondary resistance and primary current, is due to two reasons: first, that the magnetization throughout the range of working conditions is small, and second, that the magnetizing current is not in phase with the primary or the secondary currents, being nearly in quadrature with both. The exact relations of these quantities are shown by means of a vector diagram and the results of an actual test of a series transformer are given.—*Elec. Club. Jour.*, Sept.

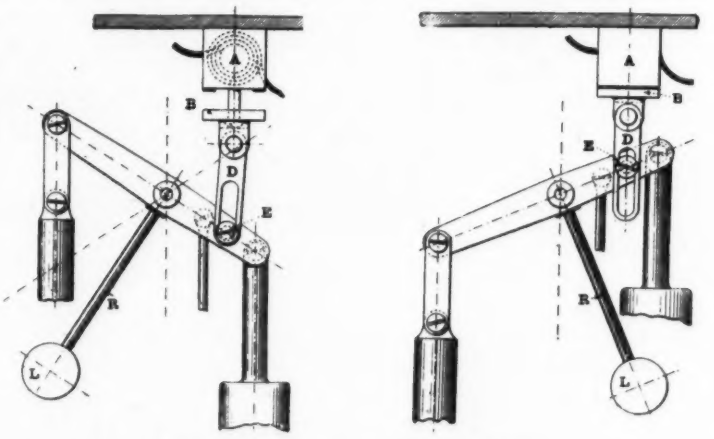
REFERENCES.

Induction Motor.—LAMME.—The first part of an illustrated article on the polyphase induction motor. The general operation of the motor is explained in a non-mathematical way, by the use of diagrams, which illustrate its characteristics under different conditions. The author describes its construction and winding, the relation between torque and armature current; he illustrates the slip by a mechanical analogue and points out the difference between the illustration and the actual case. He then deals with the electric production of a revolving magnetic field and gives the speed-torque curve. He shows that magnetic leakage limits the maximum torque, and describes the effect of secondary resistance on the speed curve. He then deals with the current curve and describes the starting of the motor with variable secondary resistance. —*Elec. Club. Jour.*, Sept.

Autotransformers.—SLONSA.—The first part of an article giving with the aid of diagrams the theory of an autotransformer, i. e., a transformer having only a single winding, the secondary being tapped off directly from the primary.—*Zeit. f. Elek.* (Vienna), Sept. 18.

LIGHTS AND LIGHTING.

Enclosed Arcs in Series.—HATFIELD.—An illustrated article on series running of enclosed arcs. In order to avoid the addition of a shunt coil, the twin-carbon lamp has been devised in which two arcs burn in series in one globe and are controlled by one series coil, but the difficulty in the design of these lamps is in feeding. Some time ago Lewis brought out a twin-carbon lamp in which the two carbons were fed by a single clutch acting on a central rod. He followed this by a lamp, in which the two carbons, still controlled by a single solenoid, were separated into two lamp bodies up to 10 feet apart, connected by a tube, through which a shaft passed attached to the levers of the two lamps. In one lamp was a solenoid only, in the other a dash-pot. Each carbon was operated by a clutch from the lever in its lamp body, and a device was used to limit the travel of the core in the solenoid, and so cause the lamp to break its arc before the clutches began to feed. Lewis has now superseded this lamp by an invention which enables him to run a number of separate lamps in series without the necessity of shunt coils. In an ordinary lamp, actuated by a series coil and clutch, feeding takes place for the first two hours or so after starting up the lamp by the travel of the core in the solenoid. The core takes up that position which gives an arc taking such a current that its pull balances the pull of the mechanism on the core, and the weight



FIGS. 1 AND 2.—CARBON-FEEDING DEVICE.

of the latter. In the usual design, the control is nearly constant throughout the travel of the core, for the weights are hung by links from a lever pivoted through its centre of gravity. If two such lamps be connected in series and started, the arcs will almost certainly begin by being of unequal length; for although the pull of the current on the core varies slightly with its position, the variation is not sufficient to insure that the cores in the two lamps will take up similar positions. In the case of the U-core design, the law of the pull would make the position unstable. In order to make series running possible, Lewis makes two modifications, which are shown diagrammatically in Figs. 1, 2 and 3. He fixes to the lever a vertical rod, carrying at its end a heavy bob L, and he adds a limiting device to prevent the lamp from releasing its clutch. The control or reaction of the mechanism now varies with the position of the core to a considerable degree. If any number of exactly similar lamps of this sort can be connected in series, the arcs will be struck and the mechanism moved as usual until the pull of the current in each balances the reaction of the mechan-

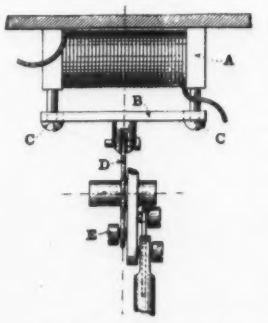


FIG. 3.—CARBON-FEEDING DEVICE.

ism. But to the steady current, whatever that may be, there will correspond in each lamp only one position of the mechanism and one length of arc which will balance the pull of that current. Since the lamps are similar the arc in each will be of the same length. As the carbons are consumed, feeding will take place by the travel of the core evenly in each lamp, if the carbons burn evenly, but the current taken by the lamps will not remain constant; it will diminish slightly, for the new positions of the core as it feeds down correspond to different currents. Before the clutches come to the release point, the limiting devices come into action, and all the lamps break their arcs and start up again. This process is so quick as to be hardly noticeable, and only occurs at intervals of two hours or so. The limiting device is constructed as follows: In series with the lamp is a small electromagnet, *A*, carrying a keeper, *B*, which is held by stops, *C*, from falling more than a short distance when the magnet is not excited. From the keeper hangs a slotted link, *D*, in the slot of which a pin, *E*, projecting from the lever of the lamp travels. The action is as follows: When the current is off (Fig. 1) the keeper falls against its stops, and the lever of the lamp is free to allow the clutch to release and the carbons to come together. When the lamp is switched on, the keeper attaches itself to the magnet, and subsequently, after the lapse of a couple of hours or so, the lever of the lamp is arrested by the pin *E* coming in contact with the end of the slot (Fig. 2). The arcs break as soon as this happens, and the lever is released. This arrangement is stated to be successful in practice, and as reliable as a singly run lamp. The necessary variation in current is very small because the pull of the solenoid on the U-core employed follows a square law; it is not sufficient to produce any noticeable effect on the light. With good carbons the consumption is sensibly the same in every lamp, since the arcs are enclosed, and any difference is rectified when the lamps renew their arcs.—Lond. *Elec.*, Sept. 9.

REFERENCE.

Enclosed Arc in Series.—Feldmann.—Another communication concerning observations made on his trip through the United States. He describes American series systems for alternating current enclosed arcs, and deals with the series transformers of the General Electric Company, the Wagner Electric Manufacturing Company and the Western Electric Company.—*Elek. Zeit.*, Sept. 1.

POWER.

Heat Radiation from Steam Pipes.—Davies.—An article pointing out that not sufficient care is taken by steam engineers to prevent the radiation loss from inefficiently covered or bare steam-heated surfaces. Every square foot of uncovered pipe costs in wasted energy per year three or four times the amount that would have to be expended in a lagging capable of reducing this radiation to the lowest quantity. He gives a list of heat-insulating materials in common use, with their approximate comparative values as heat insulators, showing what a wide difference exists between good and bad covering of equal thickness. This list is as follows: Hair felt and asbestos, in laminations, 100; cork, granulated and fire-proofed, 77; mineral slag wool, 75; fossil meal, 71; carbonate of magnesia, 70; fossil meal and hair in paste, 63; asbestos millboard, 47; fossil meal and asbestos, in paste, 46; raw asbestos, 36; large air space, 18. Hair felt is in itself combustible and unsuitable where high-pressure steam is in use; combined with asbestos in laminations it is comparatively safe. Cork to be safe must be fire-proofed, otherwise it will char, lose its mechanical strength and possibly ignite. Mineral wool, fossil meal and carbonate of magnesia are all good coverings and form the bases of most coverings. Asbestos is not nearly so good a heat insulator as is popularly supposed, but much depends upon the manner of its application to the pipe. For instance, corrugated asbestos sheet is more effective than plain, and, further, the corrugations should run round the pipe, not lengthways, as the circulation of air is thus more restricted. Concerning the thickness of the insulation, the first inch is the all-important one, the second and subsequent inches contributing less and less to the efficiency as a whole. It is advisable, however, to use a thickness of two inches, and if the work is well done this should allow for an efficient life for about ten years.—Lond. *Elec.*, Sept. 9.

Transmission Line Crossing Railroad.—Lincoln.—An illustrated article on crossing a railroad right of way by a transmission line. He proposes to adopt the following specifications covering the span which crosses the railroad right of way, as well as the three or four adjacent spans on either side. The distance from the top of the rail to the lowest point of the transmission line shall in no case be less than 30 feet; this specification need only apply to the right of way spans and need not necessarily apply to the adjacent spans. In no case shall the size of the conductor which crosses the right of way be less than 1-10 inch in cross-section. The form of a conductor shall be that of a stranded cable, the number of strands being at least 19. Only sound poles shall be used in this construction and they shall have a top diameter of at least 9 inches. The two poles adjacent to the right of way shall be braced in such a way as to make it impossible for them to fall toward the tracks. Two poles adjacent to the right of way shall be provided with double crossarms and the transmission lines fastened to the insulators in such a way that it will be impossible for the transmission line to slip through. The proper way to handle this problem is to insist upon first-class mechanical construction of the pole line at the point where it crosses the railroad company's right of way, and to take the further precaution of putting up the grounded metallic arms.—*Elec. Club. Jour.*, Sept.

Electricity in Mines.—An article on the applications of electricity at the Pixton collieries ,which are one of the oldest coal mines in England. When electric working was first adopted there, a direct current plant of 50-kw was put down, but later on it was decided that three-phase would be more advantageous. The insulation has proven successful beyond doubt and extensions are now being pushed forward with great rapidity. There are two 150-kw, three-phase alternators with 1,100 volts between the phases and a frequency of 50 periods per second. Both alternators are star-connected, but the centres are not earthed. The current is used over ground for lighting and in the workshops, where nearly all labor-saving machines are driven by induction motors. Underground current is used for lighting, coal cutting and hauling. The coal cutter is driven by a 20-hp, three-phase induction motor. Three haulage motors have been installed, two being "main and tail" gears and the other a "tail" gear; each is equipped with a 20-hp motor, running at 1,000 r.p.m., and having a wound rotor with resistance in series by which the speed may be regulated.—Lond. *Elec.*, Sept. 9.

Electric Power Field.—Walsh.—A short article enumerating the advantages which may accrue to stations supplying a low-rate power. The small consumers naturally look to the large electric power companies for their current, but the tendency of large consumers to purchase power in bulk is also very apparent. The average factory, mill or other plant not equipped for generating electric power finds, as a rule, that it is more economical to purchase the current from some outside company. Large manufacturing plants are the best purchasers of electric power, and the number of these which depend upon outside electric power increases every year. By charging low prices for power used in large quantities, electric companies can stimulate the growth of whole groups of factories along the line of their transmission.—*Amer. Elec.*, Sept.

TRACTION.

Single Traction in Sweden.—A note stating that the Government and the Congress of Sweden have granted the necessary funds for making trials with single-phase traction. The power plant is already in course of construction in Tompeboda and recently the electric locomotives and motor cars have been ordered. The power plant will contain two De Laval steam turbines directly coupled with a generator. By changing the speed of the turbines the frequency may be varied between 15 and 25. Two transformers are installed, so wound that by varying the connections between their coils, the voltage on the line may be varied between 3,000 and 20,000. Two electric locomotives have been ordered; one with two axles and two single-phase series motors and transformer and induction regulator from the Westinghouse Co., the other with three axles and three such motors and transformer and controller from the Siemens-Schuckert works. A passenger train of four cars for local service will be electrically equipped by the Allg. Elek. Ges. Two of the four cars will be motor cars, each with two Winter-Eichberg motors, the equipment being about the same as on the Spindlersfeld road. All four cars will be equipped with electric heating apparatus in such a way that no current is used for heating as long as the motors are run with full load, while with decreasing load the heating current automatically increases. The motors are wound for 6,000 volts and a frequency of 25. No decision has yet been reached whether the trolley system or the third rail shall be used.—*Elek. Bahnen*, Aug. 16.

North London.—The conclusion of the illustrated article on power

supply to tramways in North London. From the Brimstown station high-tension, three-phase currents will be transmitted to four sub-stations. The company also has another generating station at Willesden, which supplies both alternating and continuous current by means of double current generators. Unfortunately, however, the alternating current has a frequency of 25 only and cannot therefore be used for supplying the high-tension net-work of the tramway system, which has a frequency of 50. In order to enable both power stations to work in parallel, inverted rotaries have recently been installed at Willesden, and these will supply three-phase currents with the same frequency as that of Brimstown. All of the sub-stations are equipped with transformers and rotary converters.—Lond. *Elec.*, Sept. 2.

Car Lighting Resistances.—A note stating that an English company is introducing some new car lighting resistances composed of iron, the high temperature coefficient of which makes it possible to keep the current nearly constant within a certain range of voltage. In principle, a battery of, say, 30 cells, is charged from a dynamo on the locomotive, no cell switches are employed and all regulation of pressure is effected by the resistances only, of which there is one in series with every incandescent lamp. The highest pressure obtainable in this case is $30 \times 2.5 = 75$ volts, and the lowest $30 \times 1.85 = 55$ volts; the resistances, therefore, have to regulate between 55 and 75 volts. At 55 volts each absorbs 10 volts, and therefore 45-volt lamps are employed; but at 75 volts the resistance of the iron increases so much as to absorb nearly 30 volts, and therefore the pressure across the lamp terminals is kept almost constant. The actual variation of current through the lamp is said to be only 4 per cent. on each side of the mean between these limits. It is stated that higher voltage resistances are made for use on tramways.—Lond. *Elec.*, Sept. 2.

REFERENCES.

Trolley Wire.—WAHLE.—A mathematical article on the installation of the trolley wire when the wheel contact is used, especially on the position and distance of the points at which it is suspended at curves. Among other things, he shows that the position of the wheel for which the sharpest curves can be passed is perpendicular above the centre of the car, so that the usual contact arrangement in which the wheel is nearly perpendicular above the end of the car is not favorable for passing sharp curves.—*Elek. Zeit.*, Sept. 1.

Interurban Railway in Ohio.—An illustrated description of the system of the Dayton, Covington & Piqua Traction Company, the line being about 35 miles long. The boiler house is equipped with 475-hp tubular boilers, each furnishing steam to two tandem compound engines. The generators are of the direct-current type, as the line is not considered long enough to necessitate the use of alternating-current distribution.—*St. R'y Jour.*, Sept. 17.

Railway Sub-station.—An illustrated description of the new Bond Street sub-station on the Central London Railway. It contains two 900-kw rotary converters, each being worked from a separate bank of three transformers. These machines are in every respect similar to those already running in the company's other sub-stations, but there is in addition a 100-kw rotary converter, whose armature is wave wound. This wave winding simplifies the end connection considerably, only three connections being required to the slip ring instead of two per pair of poles. For starting up the rotary converters the intermediate tap method has been adopted.—Lond. *Elec.*, Sept. 9.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

French Central Station Statistics.—SOULIER.—The annual statistics of the central stations of France "are up to January 1, 1905." The tables cover 39 full pages and give in separate columns the names of the cities and counties, population, the name of the operating company and the year of its establishment, notes on lighting, the nature of the prime movers, the power installed, the type of dynamos and notes on the system of distribution, etc. No summary is given of the statistical figures, but some notes of a general character are appended. While formerly each station supplied in general a single city, there are now various stations which supply several cities in the neighborhood. This has enabled them to establish a low price of electrical energy so that now towns have electric light which never would have thought of erecting a station for themselves. Electric incandescent lamps are found in districts where kerosene lamps were hardly known before. Electric motors are used more and more in workshops, especially in Lyon, St. Etienne, Grenoble, etc. Among the great distribution network the most extended one is that of the Société méridionale d'Electricité, the total length of lines being 600 km. Electrical energy is transmitted from the St. Georges station in form of three-phase currents at 20,000 volts. Near Grenoble there are numerous water power stations, three-phase current being used for transmission at 25,000 or 33,000 or 36,000 volts. The number of smaller stations has also increased, but it is pointed out that distribution at 220 volts has not found as general introduction as had been expected, probably for the reason that good 220-volts incandescent lamps are still scarce. The old distribution system at 110 volts is still mostly used. In alternating-current systems various frequencies were formerly used, but now a uniform frequency of 50 periods a second is used in all modern installations.—*L'Ind. Elec.*, Sept. 10.

REFERENCES.

Fuses.—OELSCHLAEGER.—An account of measurements, made with the oscillograph, of the variations of current and e.m.f. while a fuse melts. The experiments were made with fuses for 20 amperes normal current, which stand 25 amperes continually and melt at 40 amperes after not more than 20 minutes. Some interesting oscillograph curves are reproduced. The fuses tested melted at 10 times the normal current (200 amperes) in 0.070 second, with 20 times the normal current (400 amperes) in 0.016 second, and 50 times the normal current (1,000 amperes) in 0.004 second.—*Elek. Zeit.*, Sept. 1.

Railway Station Installations.—PATAUD.—A long illustrated serial on new installations made by the Eastern Railroad of France in the station of Batignolles. The current is obtained from a sub-station which is supplied with three-phase, 5,000-volt, 25-cycle currents which are transformed by means of motor-generators to 500-volt, direct current. Direct current has been chosen on account of the absolute necessity to assure service without any interruption; this condition made the used of accumulators indispensable. The installations are described in detail.—*L'Eclairage Elec.*, Aug. 27; Sept. 3, 10.

WIRES, WIRING AND CONDUITS.

Sheath Losses of Three-Core Cables.—MORRIS.—An account of experiments in which the magnitude of some of these losses was determined. If a three-pole cable carries balanced three-phase currents, a magnetic field is rotating about the axis of the cable, which makes one revolution for each cycle of the alternating current. This field does not move forward perfectly steadily, but revolves in rather a jerky manner. Since the field induces eddy currents in the sheath as it revolves, it will tend to make the sheath slip around on the insulation in the same direction as that in which the magnetic field rotates. In order to determine the magnitude of this effect, the author supports the sheath in its normal position with reference to the conductors in the cable, having its axis vertical, while some of the insulation is removed between the sheath and the conductors. The sheath is then free to move. The force with which it tends to rotate is a measure of the torque, and this torque multiplied by the angular velocity of the magnetic field gives a measure of the work which is being done on the lead sheath, due to the rotating component of the magnetic field. This method has the distinct advantage over the wattmeter methods and others, that it uses the whole of the power to measure the loss, so that the expenditure of energy of 0.001 watt may be measured with an accuracy of 1 per cent. From the experiments made by the author it follows that the loss varies directly as the square of the current, as the square of the frequency and directly as the length and (within certain limits) directly as the 0.7 power of the thickness of the sheath. For a three-core cable carrying 50 amperes per phase with a frequency of 60 periods and with a thickness of insulation between each conductor 0.35 inch and the thickness of the sheath of ⅛ inch, the lead sheath loss is 17 watts per mile, while the corresponding copper loss is 5,346 watts. Hence the sheath loss is only 0.3 per cent. of the copper loss and produces no greater effect than the increase in copper loss brought about by a rise of 1° C. of the cable. Though the loss is insignificant in this case, yet when greater distances separate the conductors and larger currents are employed, the loss may become serious. Three-core cables for polyphase work are occasionally placed in iron pipes or have steel armoring, though this is not considered good practice; experiments of the author show that

the lead loss is thereby increased by 70 to 75 per cent.—Lond. *Elec.*, Sept. 2.

Electro-Physics and Magnetism.

Ionization of the Atmosphere.—Schuster.—An abstract of a British Association paper. The author points out that the continual presence in the atmosphere of free ions implies the existence of some ionizing agency. At any moment when the degree of ionization is not altering rapidly, the rate of ionizing due to this agency and the rate of re-combination of the ions must be equal. Thus a measurement of the rate of recombination gives also the degree of natural ionization which is proceeding at that time. To measure this rate of recombination, he draws the air through a tube into an electroscope of the type used by Elster and Geitel. Near each end of the tube is a tubulure, through which radium can be allowed to act on the flowing air. If the radium is placed at the end near the electroscope, an increased leak is recorded by the gold leaves; but if placed at the far end of the tube a smaller leak is obtained. The difference is due to the recombining of ions, and from it can be inferred the rate whose value is sought. This is the measure of the rate of ionization, in the air at the place of experiment, due to natural causes. Measurements of this quantity have been made at different places, and have shown that in the air of towns and in air confined in vessels the rate is much the same, and greater than in pure air at high elevations, though, it should be noticed, the actual number of ions present is usually smaller in confined air than in the atmosphere of the mountains. The author impressed on the meeting the importance of recording continuously at, say, meteorological observatories the variations of this natural rate of ionization, and promised shortly to produce an automatic registering apparatus. Incidentally, he mentioned an interesting observation he had made with his apparatus. He had found that on taking the instrument out of doors, the rate of leak observed increased considerably. He suggested that the change of temperature might produce convection currents within the apparatus, which brought into the reckoning a variety of slow-moving electrons which escaped the usual mode of measurement.—Lond. *Elec.*, Aug. 26.

References.

Nickel at High Temperatures.—Knott.—An abstract of a British Association paper on magnetic and electric properties of nickel at high temperatures. By using nickel foil instead of the nickel wire usually employed in similar researches hitherto, he found that the alteration of resistance by magnetization is perceptible in low fields. He turned this to account in studying the effect of temperature variation on the increase of resistance due to magnetization. At a temperature of 340° C. nickel becomes non-magnetic, and the resistance unalterable by magnetic force. Before falling to zero, however, the change of resistance in a given field undergoes a sudden temporary increase. It is noteworthy that the susceptibility of nickel vanishes through heating sooner in low than in high fields.—Lond. *Elec.*, Aug. 26.

Radioactivity.—Becquerel.—A continuation of his illustrated serial on the radioactivity of matter. In this instalment he deals with radium and polarium rays; the influence of a magnetic field on the radiation of radioactive bodies; and the study of β rays.—*L'Eclairage Elec.*, Aug. 27.

Units, Measurements and Instruments.

Alternating-Current Motor Tests.—Cramp.—A British Association paper on the testing of alternating-current motors by continuous current. Since an alternating magnetic field may be resolved into two equal rotating fields, each of 0.7 times the value of the original field, it follows that there is a close connection between the behavior of an alternating-current motor on its normal supply and that of the same motor having the stator supplied with a continuous current of the proper value, while the rotor is driven round at the proper speed by some independent means. As an example of this, he considers a repulsion motor. On account of the fact that such motors will usually be arranged for constant-pressure circuits, it follows that the total flux vibrating within the primary coils is practically constant. This means that the rotating fields, which take the place of the vibrating fields, are also practically constant in magnitude for any given brush position. Thus the behavior of the motor becomes similar to that of a single-phase alternator upon varying load and consequently obeys the same laws. The motor may be treated as if it were a short-circuited, single-phase alternator, and the more important tests may be carried out as follows: (1) Arrange the motor so that its stator may be excited with continuous current, equal to 1.41 $A \cos 2d$ amperes (where A is the normal magnetizing current of the motor, d the angle between the brush line and the polar axis), and so that the rotor may be driven by a continuous-current motor. (2) Calibrate the continuous current motor so that the power required to drive it at any particular speed is known. (3) Connect it to the alternating-current motor shaft (the alternating-current motor not being excited), and measure the power required at various speeds (friction and windage). (4) Drive as in (2), but with the rotor on open circuit, and stator excited with continuous current as explained above (rotor hysteresis and eddy current losses, hence, also, stator hysteresis and eddy loss). (5) Close the rotor circuit by connections which revolve with the rotor and excite as in (3), and run at what would be synchronous speed. This gives the rotor current at standstill (if desired, for various values of d). It also gives, if the speed is varied, the rotor power-factor at standstill. (6) With the same continuous current the resistance of rotor and stator may be measured. Thus all the losses of the motor are completely known, as well as the rotor current and power factor, and the performance of the motor may be predicted exactly. The author claims that the method enables a very satisfactory test to be made when alternating current of the right voltage and frequency is not available. Moreover, no wattmeter is necessary. In an editorial note it is doubted whether the test is satisfactory since it is made in circumstances absolutely unlike working conditions and all the reactions are ignored which occur between the different causes of loss.—Lond. *Elec.*, Sept. 9.

Telegraphy, Telephony and Signals.

Submarine Telephone Cables.—Breisig.—An article giving some data on the construction of some recent long-distance submarine telephone cables, that from Fehmarn to Lolland, 12 miles; Greetsiel-Borkum, 18.3 miles; Cuxhaven-Heligoland, 45 miles. In the Fehmarn-Lolland cable four cores have been used, each consisting of seven copper strands, 1.35 mm in diameter. To increase the inductance, each of the four conductors is wound with a bare iron wire, having a diameter of 0.3 mm, and then insulated by several layers of paper tape, the diameter over the insulation being 11 mm. The four cores are then grouped around a jute core, the whole being subsequently wound with paper and tape. This unfinished cable is now 32 mm in diameter. It is then impregnated and covered with two lead sheathings (each about 1.5 mm thick), the lead containing 3 per cent. zinc. Upon this there are two layers of bituminous paper and compound. The armoring consists of 19 galvanized

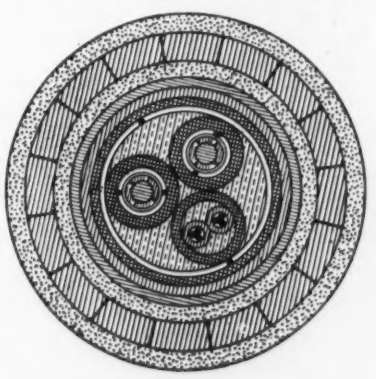


FIG. 4.—SECTION OF CABLE.

iron wires of a trapezoidal section. On top of this there are two layers of compound. If, instead of using an insulation of bituminous paper, dried paper, loosely applied, is used for this purpose, the cable would gain in capacity and a good damping might be obtained with a lighter cable. For the new cables, therefore, air insulated lead covered cables were decided upon. In considering the best construction for the cable to Heligoland (46.5 miles), it had to be borne in mind that it had to work satisfactorily with an overhead telephone line, 373 miles long, and constructed of bronze wire 4 mm in diameter. The damping of the other cables would have been too large in this case, and a reduction of the damping to a

value of about 0.007 had to be aimed at. Fig. 4 shows the section of the cable. It contains four conductors, two of which are stranded and intended for telegraphic communication, the other pair, separated from one another, serving for telephonic purposes. The latter consist of a round copper wire (2.6 mm), around which four wires are stranded. These four wires have an approximate rectangular cross-section with sides 2.4 mm and 7 mm long. A bare iron wire, 0.3 mm in diameter, is wound closely around the copper conductor. On this follows an open spiral of paper cord and a layer of paper tape, the diameter over this being 9.6 mm. Each telegraph wire, consisting of three strands of copper wire (0.89 mm in diameter), is wound with paper to a diameter of 3.5 mm. These cores are then stranded and rounded off with paper, and the whole is wound around with paper to a diameter of 9.6 mm. The two telephone cores and the telegraph core are then stranded together and the whole rounded off with paper, the diameter being about 21 mm. A distance of about 9.6 mm separates the two telephone cores. An open spiral of paper cord follows, and then there is a layer of paper and tape, the outside diameter being about 24.5 mm. After drying, the cable is provided with two lead sheathings (each 1.4 mm thick), the lead containing 3 per cent. zinc. Then there are two layers of bituminous paper and tape. An armoring of 16 galvanized iron wires follows, the final protection consisting of two layers of compound. The outside diameter of the cable is 47 mm, the weight per mile being 13.5 tons. A length of about half a mile of the Heligoland end of the cable is provided with a second armoring. Experiments on the finished cable have proved that the telegraphic communication does not disturb telephonic conversation in the least. The transmission of speech is very good both over the cable alone as also over the cable and the overhead lines in connection with it. Comparison is made with some older gutta-percha cables. The following are the electric properties of the three new cables: Resistance, 1.71, 4.86 and 1.36 ohms per km; capacity, 0.1624, 0.0742 and 0.0914 microfarad per km; self-induction, 0.00250, 0.00399, 0.00214 henry per km. Since the increase in self-induction does not keep step with the increase of the diameter of the iron-covered conductor, the limits obtained in practice are soon reached, and another further increase in the self-induction must be obtained by other means, such as those proposed by Pupin.—Lond. *Elec.*, Sept. 2.

REFERENCE.

Central Office Switchboards—O'BRIEN.—An illustrated article on the design of a switchboard for telephone central offices. The author treats of the three classes of service which must be considered in distributing the lines in such a switchboard and gives an example of the application of the methods used. The switchboard is designed to last for a period of three years, after which, as the size of the office increases and more than one trunk position is required, the first position which was originally equipped as a trunk position may be changed to a subscribers' position by a modification of the keyboard. At the other end of the board, subscribers' sections may be added as necessary.—*Amer. Elec.*, Sept.

Convention of the New England Water-Works Association.

The New England Water Works Association held its twenty-first annual convention at Holyoke, Mass., September 14 to 16. The headquarters were at the Hotel Hamilton, where the technical papers were read and business transacted. Most of the time, however, was spent in sight seeing, for which many local manufacturing concerns contributed facilities, including the Coburn Trolley Track Company, the Holyoke Water Power Company and the Deane Steam Pump Company. The latter company, especially, won the gratitude of the delegates and contributed much to the pleasure of their visit by providing a large Knox touring car, which was used, not only to convey the visitors to the Deane Steam Pump Works, but also for many other trips. One of the latter was a ride to the Ashley Pond reservoir, the new high-service reservoir and the Whiting Street reservoir, giving the water works engineers an excellent opportunity to inspect the work in connection with the high-service reservoir. The visitors to the Deane Works were entertained by Mr. Charles L. Newcomb, manager, and this company also maintained a large reception room at the Hotel Hamilton, where all visitors were cordially welcomed by Messrs. C. B. Moore and A. M. Pierce, of the Deane Company's Boston office.

Henry R. Worthington, of New York, also established headquarters at the hotel under charge of Mr. Samuel Harrison, special meter salesman. The exhibit of meters included the well-known Worthington duplex meter and also that company's disc, hot-water and oil meters. A novel and very useful application of meters has recently been introduced by this company, viz., the use of meters for measuring compressed air. This aroused great interest, not only among those who have compressed air to sell, but also with others who wished to investigate the relative economy of various compressed-air tools.

The headquarters rooms were decorated with photographs, many of which showed large Deane pumping engines in use throughout New England, and, therefore, naturally aroused the interest of the members of the association.

Lighting of Large Spaces With Mercury Arcs.

One of the most striking pieces of electrical illumination to be seen in New York City at the present time is that of the pier of the Panama Railroad Steamship Company, at the foot of West

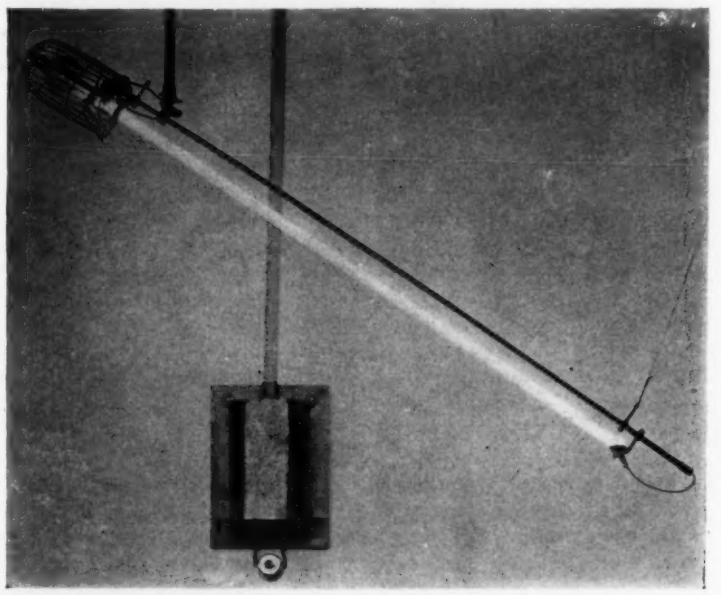


FIG. 1.—COOPER HEWITT LAMP.

Twenty-seventh Street. The lighting is done by means of Cooper Hewitt mercury arcs, and the results are so remarkable it would be hard to credit them if they could not be seen and tested for them-

FIG. 2.—STEAMER PIER LIGHTED BY COOPER HEWITT LAMPS.

selves. As a matter of fact, we believe that the pier is the largest interior space ever lit by merely six lamps, and listening to or reading the mere statement one would be inclined to discredit

it. The pier is 493 feet long, 73 feet wide, and about 35 feet high. The total floor area is about 36,000 square feet. There are only six lamps, so that each is charged with the duty of lighting about 6,000 square feet of floor space. To do this the lamps are hung

FIG. 3.—ANOTHER VIEW OF PIER INTERIOR LIGHTED BY HEWITT LAMPS.

16 feet from the floor, and are placed 81 feet apart. They are known as "Type V" lamps, each consuming 3.5 amperes at 118 volts. The lamps are installed in multiple on the 118-volt mains of the New York Edison Company, and these figures are therefore easily susceptible of an exact determination. Each lamp is, as to tube, 1 inch in diameter and 45 feet long, and is cut in and out by the wall switch shown in Fig. 1.

The sharpness of the illumination can be fairly judged from the cuts herewith, made from untouched photographs, but the lighting must be seen to be appreciated. To be sure, there is no improvement in color, but that has nothing to do with the matter in this utilitarian instance, and we have never heard of a longshoreman who worried about his complexion. The facts are that the pier is wonderfully well lit and that the work at night is now done in record time. Some real comparative tests with arc lighting under strictly analogous conditions would be at once interesting and instructive.

Gas Engines for Private Lighting Plant.

The gas engine here illustrated was designed especially to be connected direct to a dynamo, for private lighting purposes, and it meets the requirements in every respect. On a varying load it will regulate within 2 per cent., and on a steady load, within less than ½ of 1 per cent. The space occupied by the engine and dynamo is 40 by 78 in., which makes it very desirable where economy of space is necessary. Natural gas, manufactured gas or gasoline can be used as fuel.

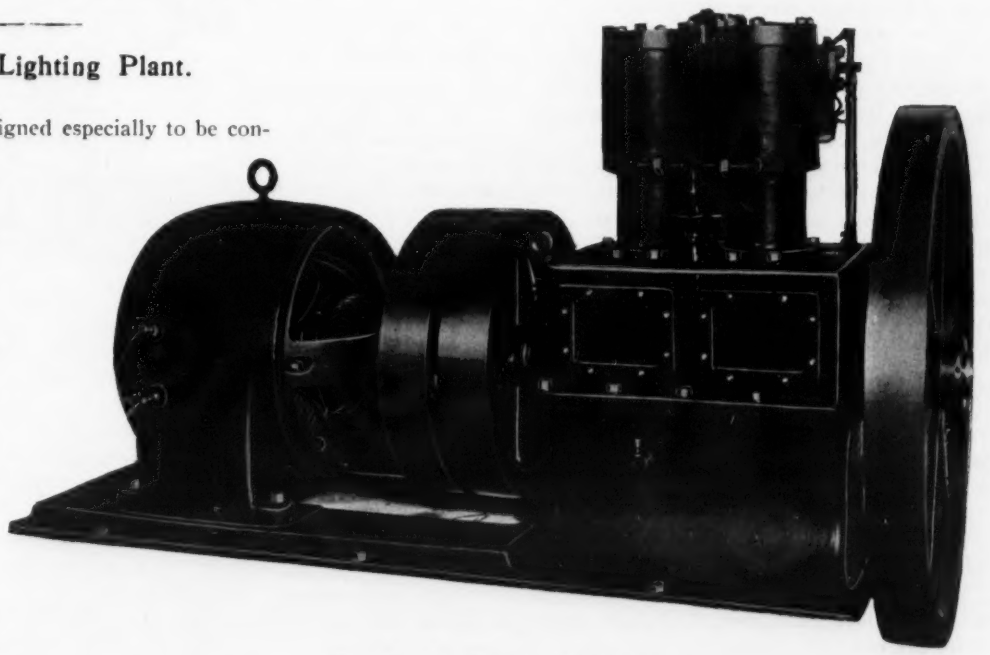
The engine is so designed that the base can be divided at the shaft line and by removing eight bolts, the entire top of the engine can be raised up without removing the cylinder heads, valves, igniters or fly-wheels. This gives free access to the bearings when it becomes necessary to replace them. There are three bearings, all of which are adjustable. The cylinder heads, valves or igniters can each be removed separately without disturbing any other part of the engine.

The cylinders are constructed of a special grade of semi-steel, thus securing a close grained hard casting, which is far superior to any cast iron. The pistons are long and are provided with improved oil rings, which give perfect lubrication, and at the same time, prevent oil working past the piston. The mixing chamber valves and igniters are all in the same casting, and free access to any of them is had by removing a cap. The valve seats are separate from the valve chest casting, and can easily be replaced in case of wear. The igniters are the "make and break" type, and are located where the incoming charge tends to cool them and the exhaust to keep them clean.

The governor is of an entirely new design. The general makeup is the well-known fly ball, but the action of the weights not only moves with the centrifugal force, but the entire governor is arranged to "float" against the force of gravity, and thus a very slight change in speed imparts a large movement to the valves in the mixing chamber.

The engine is self-oiling throughout. It is the two-cylinder, four-cycle type, and the cranks are set 360°, which gives an impulse every revolution. The cranks are carefully counter-balanced, so as to avoid any vibration. All parts are made extra heavy, thus securing long life and silent running. The quality of material used and the workmanship on the engine are of the best. No packing is used, as the joists are ground in.

The engine was designed by Mr. L. O. Langworthy, and is built by the National Engineering Company, of Bradford, Pa., which makes a specialty of illuminating engineering and installing private lighting plants. The cut shows a 10-hp engine connected direct to a 45-amp., multipolar, slow-speed dynamo, built by the Ideal Electric & Manufacturing Company, of Mansfield, Ohio. The construction of this dynamo makes it very desirable for direct-connected work.



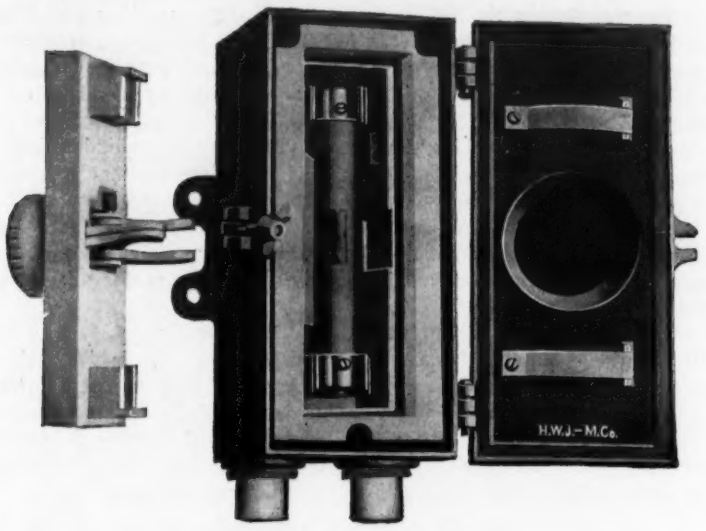
GAS ENGINE-DRIVEN DYNAMO.

Pole Line Fuse Box.

An interesting and valuable form of pole line fuse box has been brought out by the H. W. Johns-Manville Company, of New York City, embodying the Sachs "Noark" enclosed fuse. The first consideration has been to obtain maximum insulation for the current-carrying parts, and also to so protect the insulation from weather conditions that it practically becomes impervious to deteriorating influences resulting from moisture or mechanical injury. The external casing consists of a cast-iron box having a hinged cover opening sideways. The cover is provided with a rubber gasket, which forms a weather-seal between the box proper and the cover, which latter is firmly held in position by a thumb nut hasp. Inside of the iron box is a porcelain box provided with a porcelain cover and fuse holder. When in place, the cover is flush with the top surface of the porcelain box, and finds a seat on a rubber gasket placed in a ledge around the inside of the outer walls of the porcelain box.

The Sachs "Noark" enclosed fuse is held to the cover by means of the well-known "lobster claw" device, which consists of a pair of

tongs made of a specially treated insulating material, manipulated so as to clamp or release the fuse by means of a nut embedded in the porcelain handle, on the exterior of the cover. This nut works on a stud projecting from the clevis to which the claws are attached. Turning the nut in one direction causes the claws to be brought together to clamp the fuse, so that it is firmly held to the blocks on the porcelain cover. Movement in the opposite direction permits the



FUSE BOX FOR POLE LINES.

spring to open the claws and release the fuse. When clamped to the cover, the fuse and cover are manipulated as one device, and form practically a plug coacting with the contacts attached to the base portion of the porcelain box. The fuses are fitted with the so-called type "C" contacts, which consist of flat blades on each side of the fuse tube, forming a knife-blade switch contact. The receiving clips on the base of the porcelain box are made of spring metal of ample conductivity, and the insertion of the fuse into them is readily accomplished, not only due to the rounded corners of the clips, but also because the cover telescopes onto the block until it finds its seat on the rubber gasket. The arrangement is such that the box is practically closed just before the fuse reaches the contact clips. The fuse may, therefore, blow while being inserted into the clips without injury to the person who may be handling the porcelain knob on the outside of the cover.

Not the least of the many novel features embodied in this box is the method of connecting the box to the line and entirely protecting the current wires from contacting with any of the metal parts of the box. The wires enter the box through porcelain bushings at the bottom of the iron casing. These porcelain bushings are held in position by means of brass rings, which force the head of the porcelain against the bottom of the porcelain box with a rubber gasket intervening. A water-tight joint is therefore made. The hole in the bushing aligns with the hole running through the wall of the porcelain box on each side, lengthwise of the fuse. Attached to the clips in which the fuse is received, are brass castings which are so located that the hole in the castings also aligns with the hole in the wall of the box. It therefore becomes a very simple matter to insert the wire directly through the bushing into the hole in the wall of the box, and have it find its place in the connecting post. The wire is clamped, after it has been properly placed in the hole of the connecting post by screws easily reached by an ordinary screwdriver. It will be noticed that after the wire once enters the porcelain bushing on the bottom of the box it is entirely surrounded by porcelain, and is perfectly protected from leakage or contact with the non-current-carrying parts of the box.

Not only is the box protected from weather conditions by the gasket on the iron cover, but the rubber gasket on the porcelain box, under the porcelain cover, forms a second seal against moisture.

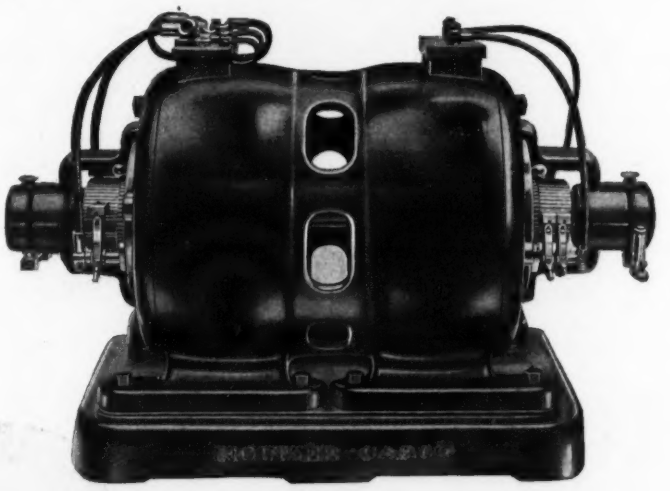
When the outer cover is closed and locked in position by the hasp, it firmly presses the porcelain cover against its gasket. Another feature which will be noticed is the fact that an air space is provided around the entire porcelain box, so that in order to leak, the current must creep from the contact part on the inside of the box up over the edge, and around the outside wall.

The cut herewith shows the box with the iron cover open and the porcelain cover at one side of the box. In manipulating the device the iron cover is opened. For inspection it is merely necessary to turn the porcelain knob so as to release the claws, after which the porcelain cover may be removed without removing the fuse. Should it be desired to remove the fuse, the porcelain cover is placed in position and the knob manipulated to clamp the fuse. The cover may then be withdrawn again with the fuse clamped thereto. This new Sachs "Noark" 2,500-volt service box is the outcome of a very careful study of the conditions to be met by a device of this kind, and although only just put upon the market it has already received most hearty approbation from central station operators.

Small Motor-Generators.

With the increase in use of the storage battery for launches, automobiles and private lighting plants has come the demand for a compact and efficient form of charging motor-generators. The advantages of the motor-generator over the dynamotor for this class of work are well known. In the first place the primary and secondary circuits of the motor-generator may be much more effectively insulated from each other than can the windings of the dynamotor. Furthermore, the secondary voltage of the dynamotor form of machine cannot be regulated except by means of a line rheostat in the secondary circuit or a speed controller in the motor circuit, using resistance in series with the armature, both these methods requiring expensive rheostats and producing a very uneconomical conversion.

The motor-generator form of machine is more flexible in its adaptation to the engineering conditions. The voltage of the secondary may be regulated by the field rheostat, and if the fields of the generator are separately excited from the motor circuit the voltage of the generator may vary from zero to the full potential of the machine, the current output and stability of voltage being retained throughout the entire range. The machines here illustrated have two bearings,



MOTOR-GENERATOR.

the two intermediate bearings being eliminated. The motor and generator cores are mounted on a common shaft which is continuous. The speeds are low and the shafts quite heavy, so there is no vibration or tendency of the shafts to spring. The output of the machines ranges from ¼ to 4¼ kw. The machine may be wound for any direct-current circuit and the secondary wound to give any voltage from 20 to 500.

The manufacturers are also prepared to supply machines of the same range and outputs of the two bearings construction, but of the open type.

There is no particular preference in favor of either type, although possibly the open type is a little more accessible. While these sets are intended primarily for charging batteries, they have been found useful in other lines of work, particularly in telegraphic work for operating main and local circuits. The Western Union Telegraph Company is using large numbers of the semi-enclosed type, while the Postal Telegraph Company has in operation quite a number of the open type, as it prefers that construction. These motor-generators are being manufactured by the Holtzer-Cabot Electric Company, Boston, Mass.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The strength of the market was irregular, bullish activity in manipulation being transferred from one part to another. There was only a limited public participation which was mainly confined to purchases United States Steel securities were very active and strong, other features being the Union Pacific and Atchison issues, the anthracite stocks and certain of the inactive industrials. Money continues to be very easy for this season. The traction stocks were neglected, apart from a temporary raid upon Metropolitan Street Railway and Metropolitan Securities. In the list of leading industrials, Allis-Chalmers preferred kept steadily at 50 throughout the week. General Electric and Westinghouse made substantial gains, the former 3¼ points, the closing price being 173½, and the latter 4 points, closing at 165. There was considerable activity in trading in Westinghouse, 11,850 shares having been sold, the range of prices being between 169 and 162. General Electric ranged between 169½ and 173½. The tractions were active in trading and strong in tone. Brooklyn Rapid Transit closed at 57⅜, a gain of 2⅞, and Metropolitan Street Railway at 121½, an increase of 3 points. Interborough Rapid Transit closed at 149, a gain of 1 point. Western Union Telegraph made a fractional gain, closing at 90¾, and American Telephone & Telegraph ⅝ point, closing at 140⅝, which is the highest figure of the year. The curb market as a whole was firm, in sympathy with the rise on the stock exchange. Electric Vehicle common gained 1½ point and preferred 5 points, the closing quotations being 18 and 25 respectively. Following are the closing quotations of October 4:

NEW YORK

	Sept. 27	Oct. 4		Sept. 27	Oct. 4
Allis-Chalmers Co.	11	11⅛	Electric Vehicle	17	16¾
Allis-Chalmers Co. pfd.	49	49	Electric Vehicle pfd.	21⅛	23⅛
American Tel. & Cable	90	90	General Electric	171⅛	172
American Tel. & Tel.	140¾	139	Hudson River Tel.	...	...
American Dist. Tel.	22	23	Interborough Rap. Tran.	149	148⅛
Brooklyn Rapid Transit	55⅞	58	Metropolitan St. Ry.	120⅛	120¾
Commercial Cable	190	190	N. Y. & N. J. Tel.	158	157⅛
Electric Boat	37	37	Marconi Tel.	...	...
Electric Boat pfd.	69	69	Western Union Tel.	90⅜	91⅜
Electric Lead Reduction	*⅛	*⅛	Westinghouse com	168¾	164
			Westinghouse pfd	180	185

BOSTON

	Sept. 27	Oct. 4		Sept. 27	Oct. 4
American Tel. & Tel.	140⅜	139¼	Western Tel. & Tel. pfd.	90	91⅛
Cumberland Telephone	116½	117	Mexican Telephone	1¼	1⅜
Edison Elec. Illum.	256½	*257½	New England Telephone	129½	130
General Electric	171½	172½	Mass. Elec. Ry.	13	13⅛
Western Tel. & Tel.	13	13	Mass. Elec Ry. pfd.	58	57⅛

PHILADELPHIA.

	Sept. 27	Oct. 4		Sept. 27	Oct. 4
American Railways	47⅜	48	Phila. Traction	97¼	97⅛
Elec. Storage Battery	64	66¼	Phila. Electric	7⅛	7
Elec. Storage Battery pfd.	64	66¼	Phila. Rapid Trans.	15¼	15
Elec. Co. of America	9⅝	9⅜			

CHICAGO

	Sept. 27	Oct. 4		Sept. 27	Oct. 4
Central Union Tel.	...	...	National Carbon pfd.	107	108
Chicago Edison	152½	152	Metropolitan Elev. com.	24	22
Chicago City Ry.	180	175	Union Traction	7⅛	7¼
Chicago Tel. Co.	122	122½	Union Traction pfd.	31⅛	38
National Carbon	36	32½			

* Asked

DIVIDENDS.—A dividend of 1¼ per cent. on the capital stock of the United Traction & Electric Company has been declared. E. W. Bliss & Company have declared a quarterly dividend of 2½ per cent. on the common stock and 2½ on the preferred.

ELECTRIC VEHICLE COMPANY'S OUTLOOK.—It would seem that Electric Vehicle is once more on the upward turn. It has had many vicissitudes. The common is selling around 18 and the preferred at 25. Last winter the quotations were 6½ and 7½ respectively. Growth in the demand for American-made automobiles is the reason given as chiefly responsible for the rise in the stock. The output of licensed automobiles, etc., next year is expected to amount in value to $2,500,000. It is stated that the company's assets include a large plant at Hartford, Conn., occupying about twenty acres of valuable real estate, where about $2,500,000 has been expended in plant and machinery. They also include the New Haven Carriage Company, an old and paying corporation, the entire stock of which is owned by the Electric Vehicle Company. They also include the well-known Seldon patent, under which so many gasoline automobile manufacturers are licensed.

BALTIMORE UNITED ELECTRIC.—N. W. Harris & Company recently made an examination of the Baltimore United Electric Company, which, according to the *Wall Street Journal*, led to the conclusion that its first consolidated 4½ per cent. bonds were selling below what they were worth. The bond house, believing that a ready market could be found for these bonds at considerably higher prices, instructed its Baltimore agents to buy all of the bonds in the market. The Continental Trust Company, one of the largest holders, sold its entire holdings to the house. Of the $3,260,000 of the bonds outstanding, about one-half were purchased. This heavy buying of the bonds naturally advanced the price until now they are quoted at 95. N. W. Harris & Company have sold over $1,500,000 at this price and interest. Thomas F. Ryan and Anthony F. Brady recently purchased a large interest in the company and they now control it. The company has issued $700,000 preferred stock which pays 5 per cent. dividends and $2,000,000 common stock on which 8 per cent. is earned. The funded debt is as follows:

First consolidated mortgage bonds outstanding in the hands of the public	$3,263,000
Reserved to refund bonds of constituent companies, due 1910-16-24	265,500
Total bonds outstanding	$3,528,500
In treasury of the company	539,000
In escrow to be issued for extensions for improvements	432,500
Total bonds authorized by mortgage	$4,500,000

The earnings and expenses for the year ending December 31 were as follows:

	1901.	1902.	1903.
Gross earnings	$712,829	$784,823	$867,826
Operating expenses and taxes	424,993	432,122	500,621
Net earnings	$287,836	$352,701	$367,205
Bond interest	159,543	159,835	159,835
Surplus	$128,293	$192,866	$207,370

The company controls practically the entire electric light and power business of the city of Baltimore.

UNITED RAILWAY COMPANY, OF ST. LOUIS.—The capitalization of the United Railway Company, of St. Louis, will be:

Bonds:	Authorized.	With trustee and in treasury.	Outstanding.
General mortgage	$42,000,000	.....	$42,000,000
Improvement 5s	10,000,000	.....	10,000,000
Preferred stock	20,000,000	$7,016,800	12,983,200
Common stock	25,000,000	86,200	24,913,800
	$97,000,000	$7,103,000	$89,897,000

This is a reduction in capitalization of $33,000,000. Working capital has been provided for the United Railways Company and a reserve of $7,000,000 preferred stock to meet future requirements.

Commercial Intelligence.

THE WEEK IN TRADE.—As confidence increases with the harvesting of the crops trade expands steadily and collections are more readily made. The cold weather also has a stimulating influence upon trade, both wholesale and retail, which shows an apparent increase in volume over a year ago. The improvement is most marked in dry goods, clothing, groceries, shoes and hardware. Settlements of labor disputes have helped in the development of favorable conditions. Among the industries some of the cruder forms of iron show some improvement, but finished products do not respond liberally to recent price reductions. The railroads are exhibiting more interest in structural steel, and the building trades will require large quantities of material as soon as the labor disputes have been settled. The copper market is dull and unchanged from the last quotations. Exportations continue at a greater pace than was expected. The closing quotations at New York were 12¾ to 13c. for Lake, 12¾ to 12⅞c. for electrolytic and 12½ to 12⅝c. for casting stock. *Dun's Review* states that the liabilities of commercial failures thus far reported for September amounted to $6,731,786, of which $2,739,362 were in manufacturing, $2,709,233 in trading, and $1,283,191 in other commercial lines. The failures for the week ending September 29, as reported by *Bradstreet's*, aggregated 203, against 153 during the corresponding week last year.

MICHOACAN WATER POWER SCHEME.—Mexican advices state that Luis MacGregos and Lorenzo Lancaster Jones, of Mexico City, have applied to the authorities for a concession which will permit of the construction of a good-sized water power plant in the State of Michoacan. The applicants propose to construct a canal and a tunnel from Patzcuaro Lake, measuring together about 12 miles and having a capacity to carry 8,000 liters of water per second. The current developed will be utilized for power purposes in the vicinity.

INDIAN POWER TRANSMISSION.—The construction of a power transmission plant is projected in the Himalayas, it being proposed to establish a plant in the vicinity of Mussoorie, for the purpose of furnishing power for that popular Hill station. Mr. S. P. Billingshurst, of the Bikauer State service, has drawn up a report on the scheme. Power for electric lighting purposes is proposed to be derived from the Kumpti Falls. The quantity of water available for power in very dry seasons is 6½ cubic feet per second, which is estimated to be sufficient for 434 effective hp. For the water supply of Mussoorie, it is proposed to utilize certain springs located between Kumpti and Mussoorie. The project as worked out provides for the lighting of 13½ miles of roads and for the supply of electricity for the purpose of lighting Mussoorie and Landour. The surplus current, which is not required for street lighting and pumping, will be largely used for private lighting and heating, especially the latter, as fuel is very expensive and the climatic conditions necessitate a large expense for this purpose. The material, etc., required for the construction of the plant will include 4,000 feet of steel double riveted pipe 12 in. x 14 in. in diameter. The initial generating equipment will consist of four turbine sets and two turbine exciter sets. The normal power will be developed by any one of the three generators. The generators are calculated to produce 400 kw. The load being variable and fluctuating, a dam will be built after the present power is taken up, and will have a capacity to about 800 hp. The turbines to be used will be of the Pelton wheel type fitted with electric governors and designed for a speed of 600 r.p.m. with a direct drive to the generators. The generators will be of alternating current, three-phase, 60-cycle revolving field type to give 5,500 volts at 600 r.p.m. They will be excited by two separately driven compound-wound multiple machines, each able to excite any three of the alternators, and to supply in additional current for the lighting of the plant. There will be twelve transformers, each of which will be placed in a separate house in the center of each of the twelve districts. The transformers will vary from 5 kw to 70 kw each. The energy will be delivered to consumers at 225 volts.

THE POWER & MINING MACHINERY COMPANY has been awarded a contract by the Western Gas & Fuel Company for one two-cylinder American-Crossley gas engine, 28 in. by 36 in., single-acting; speed, 130 r.p.m.; normal b.h.p., 510; maximum, 570; direct connected to two Ingersoll-Sergeant 14¼ in. by 36 in. single-acting compressors; cylinders located in tandem to the gas cylinders. This plant is to be used for compressing gas entering the cylinders at an initial pressure of 50 lbs., and discharging at 350 lbs. Making the compressors single acting and in tandem with the gas engine cylinders, not only gives the advantage of direct connection, but does away with the necessity of high pressure stuffing boxes in the gas compressor cylinder heads. The gas will enter the compressor cylinder at the end nearest the gas engine and will pass through the piston inlet valve to the other side on the forward stroke of the engine, compressing on the return stroke. This construction permits of minimum clearance in the compressing end of the cylinder and at the same time effectually prevents any chance of leakage of gas into the room; any leakage past the piston, as will be seen, returns to the inlet side. The company's guarantees cover the gas consumption of the engine when operating at rated load, at 500 b.h.p., at which load they have guaranteed a gas consumption of 11½ cu. ft. of natural gas having a calorific value of 1,000 B.T.U. per cu. ft. It has further guaranteed that with 1,000 cu. ft. of gas used in the gas engines, of this value, 36,480 cu. ft. of gas per minute, measured at atmospheric pressure, will be delivered. It is a well-known fact that gas pumping plants in Indiana and Ohio at the present time are using practically 25 per cent. of the output of the wells for pumping. The plant to be installed by the Power & Mining Machinery Company will easily do the work on 3½ per cent.

LARGE SOUTH AMERICAN TELEPHONE CONTRACT.—One of the first and largest telephone equipment contracts secured by any independent manufacturer in the United States from South America, against strong competition from foreign telephone manufacturers, has recently been secured by the International Telephone Manufacturing Company, of Chicago, from the Comp. Telephonica do Estado de Sao Paulo, of Sao Paulo, Brazil. The local telephone company was represented by Eduardo de Aguiar D'Andrada, chief electrical engineer of the Sao Paulo Railway Company, and Edgard de Souza, chief electrical engineer for the Sao Paulo Telephone, Light & Power Company, who investigated thoroughly the systems, tested sample parts and passed on the tenders from the various manufacturers in the United States and the foreign manufacturers. The contract consists of a 4,000-line capacity multiple self-restoring drop generator-call switchboard, fully equipped for the immediate operation of 1,500 lines, including complete power plant, storage battery set for busy test, pilot lamp, operators' instruments, etc., together with main and intermediate distributing board rack, lightning arresters and sneak current protectors, all complete, ready for installing. The equipment is for replacing and greatly enlarging the company's present system, which is to be extended to thoroughly cover the entire city of Sao Paulo, which, at the present time, has a population of nearly 100,000 inhabitants.

AUGUST EXPORTS AND IMPORTS.—The classified statement of imports and exports for August and for the eight months ending August shows: For August, imports of $87,738,191, against $82,049,262 last year, or an increase of approximately 7 per cent.; for the eight months, imports of $667,244,396, against $676,981,594 last year, or a decrease of approximately 1⅖ per cent. The exports for August stand at $90,090,659, as against $87,556,344 last year, or an increase of about 3 per cent. The exports for the eight months are $833,098,727, against $859,659,331, which is a decrease of about 3 per cent. The exports for August exceed the imports by $2,352,464, and for eight months the exports exceed the imports by $165,854,331. The remarkable fact is that manufactured exports in August, 1904, were $42,415,644, or nearly $9,000,000 more than in 1903 or 1902.

UNITED STATES GOVERNMENT TELEPHONE INSTALLATIONS.—To those who are not in close touch with the large amount of work being done by the Government in the line of equiping its different department divisions with telephone apparatus, it will be interesting to know that the American Electric Telephone Company, of Chicago, has recently supplied the United States Government with switchboard exchange equipments divided into twelve different divisions: Six switchboards being sent to different points in Virginia; one switchboard to Wyoming; one switchboard to New York; three switchboards to different points in California, and another switchboard to the District of Columbia. This indicates a great activity on the part of the Government officials in adopting the telephone as a means of communication.

NORTHERN ENGINEERING WORKS, crane builders, Detroit, Mich., report among recent shipments and sales of electric and hand traveling and jib cranes the following: United States Lighthouse Board, Detroit, two 6-ton; Van Dorn Iron Works, Cleveland, one 15-ton electric; Proximity Manufacturing Company, Greensboro, N. C., one 20-ton; Barnhart & Davis, Warren, Pa., one 5-ton; Dow Chemical Company, Midland, Mich., one 5-ton; City of Springfield, one 15-ton, with runway complete. They report a large increase of inquiries and quotations during the past month and an increasing demand for their electric trolley hoists for power plants, etc.

EQUIPMENT FOR BINGHAMTON OFFICE.—The Security Mutual Life Insurance Company's new office building at Binghamton, N. Y., is to have an electric lighting plant consisting of 60 kw and 40 kw Westinghouse dynamos, direct-connected to Ridgway 13-in. x 12-in. and 11-in. x 10-in. horizontal simple automatic high-speed engines. Mr. Percival Robert Moses, of 35 Nassau Street, New York, is acting as electrical engineer in the matter.

BURT OIL FILTERS.—The export trade of the Burt Manufacturing Company, of Akron, Ohio, is certainly one to be proud of. The company has recently sent six oil filters to supply its trade at St. Petersburg, Russia, and 27 oil filters and exhaust heads to its agency at Genoa, Italy, as well as a shipment of 12 exhaust heads and 3 oil filters to its agency at Malmo, Sweden.

EQUIPMENT FOR N. J. STATE HOSPITAL.—A large State hospital for consumptives is to be built at Glen Gardner, N. J. Pattison Brothers, Flatiron Building, New York, will be the engineers for the electrical equipment, which will include two 100-kw direct-current generators direct-connected to 150-hp engines.

EQUIPMENT FOR WOOD-WORKING FACTORY.—Knowles & Kelly, of Troy, N. Y., have the contract for the engines to be installed in the new wood-working factory being built at Hancock, Mass. At the time of writing the contracts for the generators and motors were not awarded.

CAPSTANS AT NAVY YARD.—The Hyde Windless Company, of Bath, Me., has submitted the lowest bid, at $4,425, for furnishing and installing three electric dock capstans, with 15-h p motors, at the Charlestown Navy Yard.

EQUIPMENT FOR PRINTING PLANT.—The Etna Life Insurance Company, of Hartford, Conn., is to operate its printing establishment by electricity and has placed a good-sized order for small motors with the Crocker-Wheeler Company, of Ampere, N. J.

GENERAL ELECTRIC EQUIPMENT FOR INDIA.—The General Electric interests have secured a substantial contract for electrical equipment and supplies from the East Indian Railway.

General News.

THE TELEPHONE.

PELL CITY, ALA.—The town of Pell City has granted a telephone franchise to George L. Wilson, and within thirty days the line will be under construction. It will connect Pell City, Easonville and Coal City.

EUREKA, CAL.—A 50-year telephone franchise has been awarded to the Upper Nattole Telephone Company.

SAN LUIS OBISPO, CAL.—Sealed bids will be received until Nov. 9 for a telephone franchise in this county, as applied for by Adolph Phillips. H. H. Carpenter is County Clerk.

COLORADO SPRINGS, COL.—M. H. Sphere and associates were granted a 20-year franchise by the City Council of Manitou to build and operate an independent telephone system there.

WASHINGTON, D. C.—At a recent Cabinet meeting, Secretary Morton reported progress in his investigation of a proposed interdepartment telephone service. Secretary Morton was requested to report on the subject some weeks ago, when the public telephone service charges were raised to what the department chiefs thought exorbitant figures.

COCOA, FLA.—The Brevard County Telephone Company has been incorporated with a capital stock of $5000. The incorporators are H. S. Williams, Joseph Paxton, G. S. Hardee, S. S. Jones and R. N. Andrews.

MARIETTA, GA.—The Southern Bell Telephone Company is expending $15,000 in improvements here. The City Council recently refused a franchise to another company seeking admission to the city.

SHELBYVILLE, IND.—The Central Union Telephone Company is planning a new plant and exchange in this city.

WEST COLLEGE CORNER, IND.—The Home Telephone Company has increased its capital stock from $4000 to $25,000.

DECATUR, IND.—The Citizens' Telephone Company, of Decatur, has increased its capital stock from $6000 to $50,000. The company proposes to make extensive improvements, including a new switchboard.

CRAWFORDSVILLE, IND.—A. F. Ramsey, president of the Home Telephone Company, has contracted with the long-distance company, of Indianapolis, for a new long-distance line from here to that city.

ESTHERVILLE, IA.—The Emmet County Telephone Company is seeking a local franchise.

WATERLOO, IA.—The Iowa Telephone Company is beginning work on an underground system and central office building at Waterloo.

BURLINGTON, IA.—It is stated that as rapidly as the change can be brought about the management of the Chicago, Burlington & Quincy Railroad has decided to substitute the telephone for the telegraph in dispatching and operating both passenger and freight trains. This decision was made after comprehensive trials of the telephone had been made on various portions of the company's lines for several years.

RAYMOND, ME.—The Raymond & Webb Mills Telephone Company has been organized for the purpose of constructing and operating telephone lines in the towns of Raymond, Casco, Gray and Poland, in Cumberland County, with a capital stock of $10,000. The officers are: President, F. W. Plummer; treasurer, G. H. Hall, both of Raymond.

SOUTH HAVEN, MICH.—The Kibbies Telephone Company has purchased the entire business of the Twin City Telephone Company in Van Buren County and to the north. This includes a small exchange at Covert, a few telephones at Hartford and a number of country telephones in South Haven and Casco townships.

ALBION, MICH.—A number of independent telephone men have applied to the council for a franchise to operate a telephone system, and offer to pay $50 per year for the franchise and to furnish five free telephones for city offices. The promoters further agree to allow the use of their poles for fire alarm purposes.

READING, MICH.—The Reading Central Telephone Company and the Michigan Telephone Company have made an agreement which gives the Bell people exclusive right to the local exchange in Hillsdale and the Reading Company the rest of the county. The Bell people transfer their local exchange in Reading to the local company, thus giving the latter a neat little business of over 400 rural telephones in the county. This agreement also gives the subscribers of either company free exchange between Hillsdale local and Reading local or rural.

TWO HARBORS, MINN.—E. J. Cooper contemplates building a telephone line 110 miles long from here to Grand Marais, Minn.

ST. PAUL, MINN.—The Morrill Rural Telephone Company has been incorporated with a capital stock of $50,000. The company will build a line connecting the towns of Graham, Morrill and Buckman, in Benton and Morrison counties.

MINNEAPOLIS, MINN.—The American Telephone & Telegraph Company, removed from St. Paul, will be installed within 60 days in the new addition to the Northwestern Telephone Company's building. About $150,000 will be expended in the work of changing toll line headquarters to the Minneapolis office.

JEFFERSON CITY, MO.—The Kinloch Long Distance Telephone Company has increased its capital stock from $2,000,000 to $3,000,000. The new capital is to be employed in extensions of the system.

BROWNING, MO.—The Browning Telephone Company, of this city, has been incorporated with a capital stock of $1000, all paid. The incorporators are S. L. Gibson, F. M. Haymaker, M. R. Jenkins, J. J. Smith, E. B. Fields and others.

ADAMS, NEB.—A telephone company has been formed with W. C. Gray as secretary.

HARVEY, N. D.—W. B. Bascom, the new owner of the telephone exchange, will rebuild the system.

SANTA FE, N. M.—The Bell Telephone Company will probably ask for a franchise in Santa Fe. Its subsidiary corporation, the Colorado Telephone Company, which recently extended its Denver line to Las Vegas, plans an extension to Santa Fe, Cerrallos, Albuquerque Belen and Socorro, at an expenditure of $100,000.

PERTH AMBOY, N. J.—The Perth Amboy City Council has refused to grant the Hudson and Middlesex Telephone & Telegraph Company a franchise. The company has been in operation here and in Woodbridge for two years and the franchise ordinance just defeated was before the council nearly a year. The Hudson and Middlesex Company agreed to place and maintain free telephones for the police and in all public buildings, including schoolhouses. The wires were to be placed in underground conduits and the life of the franchise was to be twenty-one years.

NORTH TONAWANDA, N. Y.—The Bell Telephone Company, of Buffalo, has succeeded in getting the Common Council to grant it a 25-year franchise.

NEW YORK, N. Y.—The private telephone system of the New York Central Railroad, between this city and Chicago, has been opened and is now in regular service.

KERNERSVILLE, N. C.—The Kernersville Telephone Company has been chartered with a capital of $5000 by W. C. Linville, G. V. and M. V. Fulp, of Linville and F. W. Lubert, of Waterbury, Conn.

PLATTSBURG, OHIO.—The Home Telephone Company has increased its capital stock from $10,000 to $20,000.

MIAMISBURG, OHIO.—The Village Council of Miamisburg has granted a franchise to the Montgomery County Telephone Company.

MARTINS FERRY, OHIO.—The Belmont & National Telephone Company's lines from Wheeling and this city to Pittsburg have been completed and the service is now being used.

COLUMBUS, OHIO.—The Jackson County Home Telephone Company has filed an amendment to its charter so that it may extend its lines through Jackson, Pike, Ross, Gallia, Vinton, Lawrence and Scioto counties.

CLEVELAND, OHIO.—The Cuyahoga Telephone Company is considering the advisability of establishing public telephones upon the streets. The plan of the company is, if permission is obtained, to operate a large number of public telephones in this manner. They will be the same as pay stations, except that they will not occupy the usual room of a pay station. They will be attached to posts, and in this way take up no more room than an ordinary telephone pole. Two telephones have been installed as a test merely to see how the public takes to them, and if they will be of any public convenience, aside from the profits that might be derived.

DUSHORE, PA.—The Sullivan County Telephone Company has been formed; capital, $5000.

LITTLETOWN, PA.—The United Telephone & Telegraph Company will rebuild its entire line in this place.

DOYLESTOWN, PA.—The Delaware & Atlantic Telephone & Telegraph Company has been granted permission to construct and maintain a telegraph and telephone system in this town.

NEWCASTLE, PA.—The Citizens' Telephone Company, of Newcastle, Pa., the Union Telegraph & Telephone Company, and the Mercer County Telephone Company are included in a merger of all independent companies of western Pennsylvania and western New York under the name of the Erie Telephone Company.

PITTSBURG, PA.—It is expected that the independent telephone line which is to connect Pittsburg with Wheeling and which is being constructed by the Pittsburg & Allegheny Telephone Company and the National Telephone Company of Wheeling, will be in operation about November 1. The line is being built from Bridgeville toward Wheeling on a private right of way. The new line will add 3000 telephones at Wheeling to the list of the independent company, and give further connections in West Virginia and Ohio.

WALTERBORO, S. C.—Books of subscription have been opened for the Colleton County Telephone Company, which proposes to connect every part f the county with Walterboro. A local system is also being installed. Dr. T. B. Whatley is interested.

GEDDES, S. D.—Application has been made to the council for a franchise for telephone.

LONGVIEW, TEX.—The Lacey Telephone Company has been incorporated with a capital stock of $35,000. The directors are J. C. Lacey, J. Collins and others.

DALLAS, TEX.—F. B. McElroy, of Dallas, and S. A. Jones, of Chicago, have filed with the City Secretary a petition for a telephone franchise in the city of Dallas, for twenty years. In its petition the association offers to pay to the city of Dallas an annual bonus of 3 per cent. of the gross receipts from the operation of its local exchange and guarantees that this bonus will amount to not less than the total sum of $50,000 during the life of the franchise.

SHAWANO, WIS.—The Marion & Northern Telephone Company contemplates extending a line to this city.

MILWAUKEE, WIS.—The Wisconsin Telephone Company will make extensive improvements to its system, costing $350,000.

PEWAUKEE, WIS.—The Pewaukee & Sussex Telephone Company has been incorporated with a capital stock of $25,000. The directors are A. T. Larson, S. E. McDowell and others.

ELECTRIC LIGHT AND POWER.

GLOBE, ARIZ.—C. M. Clark is interested in a project to develop an electric power plant on Salt River, of 8000-hp, to furnish power for this town and the mines. It is estimated that the plant will cost $2,000,000.

NASHVILLE, ARK.—It is proposed to install a municipal electric light plant.

LOS ANGELES, CAL.—The Union Power Company has filed a trust deed for $1,000,000, which evidences a coalition of the rival power companies operating in this section. The deed covers water rights, power houses and all property of the company in the Santa Ana River and Bear Creek districts.

SANTA CRUZ, CAL.—The Big Creek Power Company's magnificent electric plant has been put in operation. It is a 3-phase transmission at 11,000 volts to Santa Cruz. Its capacity is sufficiently great to meet local and distant demands, and machinery in both Watsonville and Santa Cruz will be driven by this current.

SAN FRANCISCO, CAL.—The Standard Electric Company, of California, has levied an assessment of $10 per share on the capital stock of the company, delinquent Oct. 21, sale day Nov. 12. Several months ago the California Gas & Electric Corporation acquired control of the Standard Electric Company, which is capitalized at $5,000,000, in 50,000 shares of a par value of $100 each, and has a bonded indebtedness of $5,000,000 five per cent. bonds, due Sept. 1, 1939. The California Gas & Electric Corporation guarantees these bonds, of which it owns $2,000,000. It also owns more than 90 per cent. of the Standard stock. The assessment was necessary to increase the capacity of the Standard electric power plant at Electra from 13,000 horse-power to about 30,000 horse-power, and to make other improvements. The total expenditure contemplated is about $1,000,000. Two additional 5,000-kw, 3-phase Stanley generators have been ordered for this plant, which transmits power as far as San Francisco, a distance of 145 miles.

SAN FRANCISCO, CAL.—The Tuolumne Electric Company, R. W. Hersey, president; C. W. Quilty, secretary, has filed, at San Jose, a certificate of a bonded indebtedness of $60,000, the proceeds to be used for the purchase of electric and hydraulic machinery. The new plant is to be installed on the Tuolumne River to supply electric power to neighboring mines and to the towns of Groveland, Big Oak Plant, Sonora, Jacksonville and Coulterville. Contracts have been made for the entire output.

SALIDA, COL.—The Salida Light, Power & Utility Company has been incorporated with a capital stock of $50,000.

WASHINGTON, D. C.—Bids will be received Oct. 11 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing the navy yards of Norfolk, Va.; Port Royal, S. C., and Charleston, S. C., a quantity of steel conduit, Greenfield metallic conduit, conduit fittings, arc lamps, Jandus arc lamps, incandescent lamps, arc lamp globes, electrical supplies, iron pipe, pipe fittings, valves, tight joint fittings, Davidson steam pumps, Blake duplex pumps, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

GRACEVILLE, FLA.—Robt. Boone, of Marianna, has secured a franchise for an electric light plant and water works.

GRIFFIN, GA.—The electric light plant is to be improved, bonds having been sold for this purpose.

WAYNESBORO, GA.—The City Council of Waynesboro has advertised for bids for the new water and electric light plants which it is expected will be completed by January 1.

COLUMBUS, GA.—It is understood that the Columbus Power Company, which controls large electric works at Lovers Leap, is offering to make contracts for secondary power at $10 per horse-power per annum. At present power is furnished at $15 per horse-power per annum to run plants in the city in the day time. It is proposed to use this same power at night in a lighting plant, as it can be had at $10 per horse-power per annum.

COMPTON, ILL.—The Compton Electric Light Company, of Compton, has been incorporated; capital, $25,000. Incorporators: J. S. Richardson, L. W. Kutter and W. N. Hills.

MONMOUTH, ILL.—The Monmouth Gas & Electric Company has been incorporated with a capital of $200,000. Incorporators: W. A. Thompson, Chas. B. Wood and Horace S. Oakley

TROY, IDA.—The City Council has granted the Troy Manufacturing Company a franchise for an electric light plant.

PORTLAND, IND.—The City Council has voted to build and equip a city electric light plant. The city owns the dynamos, and has been leasing the power to operate them.

MUNCIE, IND.—Jerome Herff, of Peru, is at the head of a company to build a dam in the creek in West Muncie and erect an electric lighting plant to be operated by water power. One hundred thousand dollars will be expended in the project.

EARLHAM, IA.—It is reported that Hill & Johnson contemplate constructing an electric light plant.

WAVERLY, IA.—It was voted to construct a municipal electric light plant here. F. H. Munger is City Clerk.

WEBSTER, KY.—The Sebree Light & Power Company of Webster has been incorporated with a capital of $10,000.

CHESTERTOWN, MD.—The business men of this city are organizing a company to install and operate an electric light plant.

BOSTON, MASS.—The Board of Water, Light & Power Commissioners of Fenelon Falls have closed a contract with the Ambursen Hydraulic Construction Company of Boston, as engineers and contractors, for a power dam for a municipal lighting plant in the Fenelon River.

GUANAJUATO, MEX.—The Guanajuato Electric Light & Power Company is preparing to build other transmission lines to the towns of La Barca, State of Jalisco, and to Celaya, State of Guanajuato.

GALIEN, MICH.—The question of establishing a lighting plant here is under consideration.

LAKE LINDEN, MICH.—The Calumet & Hecla Mining Company is planning to install an electric plant at this point.

MILLERSBURG, MICH.—The Onaway Electric Lighting Company, of Onaway, is considering the extension of its line to Millersburg.

MANISTIQUE, MICH.—The Manistique Light & Power Company will start work at once on a new plant. McArthur Bros. & Company, of Chicago, Ill., have the contract for construction. The plant will cost $50,000.

NEW ALBANY, MISS.—W. F. & A. D. Wilcox, of Jackson, have been employed to prepare plans and specifications for a $20,000 water and electric light plant. Bids will be received until Oct. 21 by W. H. Liddell, Mayor, for $20,000 electric light and water works bonds. E. M. Owen is City Clerk.

ABERDEEN, MISS.—Aberdeen has just passed from a city with private ownership of the lighting plant to one with municipal ownership. The plant will be operated in conjunction with a system of water works and sewerage.

GENEVA, NEB.—The Nebraska Electric & Fixture Company, of Omaha, Neb., has secured a contract for the complete installation of an electric light system at Geneva, Neb. Work will be commenced immediately.

LINCOLN, NEB.—Sealed proposals will be received at the office of the City Clerk of Lincoln until 2 p. m. on the 18th day of October, 1904, at which time the proposals will be publicly opened and read, for furnishing any or all the following parts—poles, lines and lighting circuits, boilers, engines, feed water heater, boiler feed pumps, electric generators, switchboards, series alternating arc lighting regulators or transformers and arc lamps, and constant potential transformers, to be employed in the construction and equipment of a complete electric lighting system for the city of Lincoln to supply 328 street lights, all in accordance with plans and specifications on file in the office of the city engineer and city clerk.

ALBUQUERQUE, N. MEX.—The Albuquerque Electric Power Company has been organized here with a capital stock of $50,000. The incorporators are William L. Iliff, William B. Childers and Edward Callen.

SUNAPEE, N. H.—The Newport Electric Light Company has purchased the electric light plant at Sunapee.

UNION HILL, N. J.—The Board of Public Service has the contract for lighting the town and public buildings, at $85 for each arc light per year for a 5-year term.

WOODBURY, N. J.—The City Council has appointed a committee to look into the feasibility of constructing an electric light and gas plant to be owned or operated by the city.

OLEAN, N. Y.—The Genesee Valley Power Company has been incorporated with a capital of $25,000 by W. L. Young, of Fillmore, and Geo. Forbes, of Olean.

HENDERSONVILLE, N. C.—The Hendersonville Light & Power Company is completing a new power plant on Big Hungry Creek and the wires are being strung to the city. The power will be used for lighting purposes.

LEEDS, N. D.—Manager Candee, of the Leeds Telephone Company, has installed a small dynamo and is furnishing light for buildings in which he is interested. He thinks the town could support an electric light plant.

CANAL DOVER, OHIO.—The A. Beyer & Leiser Electric Company has renewed a five-year contract for lighting the city. The contract price is $54.44 for each arc light, of which there are seventy-nine.

WILKESBARRE, PA.—The plants of the Luzerne County Gas Company and the Wyoming Valley Electric Light Company have been sold to Forrest & Company and Chas. B. Miller, of Philadelphia, and J. G. White & Company, of New York, N. Y., representing Philadelphia and New York capitalists. The new company will have a capital of $1,500,000, and an authorized bond issue of $3,000,000. The plants of both the gas and electric companies will be extended, and other improvements made, which will cost about $500,000.

WESTMINSTER, S. C.—This town is considering the installation of an electric light plant.

SPARTANBURG, S. C.—Engineer Geo. E. Ladshaw, of Spartanburg, has let contracts for the hydraulic and electrical machinery for an eleven-mile transmission on Pigeon River. The power is to be carried to Waynesville, N. C., to be used for lighting the town and for other purposes. The promotor of the enterprise is B. J. Sloan, of Waynesville.

SPRINGFIELD, TENN.—Ground has been broken for the erection of the city's water and electric light plants. The contractors have promised the completion of the plants to be turned over to the city Dec. 1.

WICHITA FALLS, TEX.—The Wichita Falls Electric Light Company has been incorporated with a capital stock of $15,000.

HAMPTON ROADS, VA.—The work of installing a new electrical system at Fort Munroe has begun. The fortress will be equipped with new telephone, light and signal systems, and the contract will amount to about $75,000.

RUTLAND, VT.—Archbold-Brady Company, of Syracuse, N. Y., has secured the contract for a power house for the Chittenden Power Company, of Rutland, to be constructed at Mendon. It will have a capacity of 2000 horse-power, which will be utilized by the Rutland Street Railway Company and for commercial purposes. The probable cost is $125,000.

MAUSTON, WIS.—The Mauston Electric Light & Power Company and the Mauston Telephone Company have been merged and the plants will be refitted. The dam will be rebuilt.

JOHANNESBURG, S. A.—The electrical engineering firm of Harris, Lee & Company, of Johannesburg, South Africa, has secured the concession for the lighting of the town of Bethlehem, Orange River Colony.

THE ELECTRIC RAILWAY.

PETERSBURG, ILL.—The name of the Springfield, Petersburg & Beardstown Interurban Railway Company has been changed to Springfield, Beardstown & Quincy Interurban Railway and the line will be extended to Quincy. A franchise has been granted from Petersburg to Beardstown.

JOLIET, ILL.—A contract has just been made by the Bloomington, Pontiac & Joliet Electric Railway Company for two cars to be equipped with the General Electric Company's new single-phase, alternating-current motors. These are to be used on the 20 miles of line which this company expects to have completed by the end of the year between Pontiac and Dwight, Ill. As it is not expected that the cars on this road will be required to operate over direct-current trolley lines, the series parallel method of control will not be used, potential control being used instead. The road is being constructed and the engineering work is being done by the Arnold Electric Power Station Co., of Chicago. Current will be supplied at 2300 volts, 25 cycles, from a generator in the plant of the Pontiac Light & Water Company, the generator feeding direct to the trolley line.

LAPORTE, IND.—Chicago and Illinois capitalists have secured control of the Chicago & South Shore Electric Railway, and it is about to go out of the hands of receivers. An election that has just been held resulted as follows: O. D. Mallory, of Batavia, Ill., president; R. L. Henry, of Chicago, vice-president; A. M. Hews, of Chicago, secretary; O. W. Leeds, of Michigan City, treasurer. The line extends from Michigan City to Laporte, a distance of 15 miles.

ALDERSON, IND. TER.—The Indian Territory Traction Company is extending its electric line from Alderson to Garthshorne, a distance of nine miles. It is already in operation from South McAlester to Alderson, a distance of six miles.

BANGOR, ME.—The State Street Trust Company, trustees under a mortgage, will sell the property and franchises of the Penobscot Central Railroad at public auction Nov. 1 at Bangor.

BALTIMORE, MD.—Representatives of a New York syndicate have made a deal with E. L. Tunis, of Windsor Hills, the holder of a patent upon a mono-rail system, for the purchase of the patent by the American Monorail Company. Among those present at the conference were J. Coleman Drayton, John H. Ostrup, A. Norval, Henry A. Seymour and George L. Upshur, of New York, and Henry L. Williams, Ruxton Ridgley, E. L. Tunis and H. H. Tunis, of Baltimore. The contract has been given for the completion within two months of a five-mile track for testing purposes from Baltimore to a point on the Patapsco River. The motive power will be electricity. The ultimate object of the company is the construction of a quick line from this city to Washington.

GUADALAJARA, MEX.—An American syndicate, composed principally of Chicago capitalists, and represented in Mexico by ex-Governor William T. Thornton, of New Mexico, has applied to the government of the State of Jalisco for a concession to establish a complete system of electric street railway in this city.

LANSING, MICH.—The Adrian & Jackson Traction Company has been incorporated, with a capital of $320,000. J. W. Helme is one of the directors.

DETROIT, MICH.—The Lansing City Electric Railway and the Lansing, St. Johns & St. Louis Railway have been merged. The new company, which is known as the Lansing & Suburban Traction Company, has authorized a bond issue of $750,000 to take up the bonds of the underlying companies and provide for further extensions.

FARGO, N. DAK.—The directors of the Fargo & Moorhead Street Railway Company have organized as follows: L. B. Hanna, president; W. A. Scott, vice-president; J. W. Smith, treasurer; R. E. Heath, secretary.

OSWEGO, N. Y.—At the annual meeting of the stockholders of the Oswego Traction Company the following directors were re-elected: C. A. Tanner, L. Clancy, D. A. Williams, N. S. Bentley, James P. Doyle, C. Sydney Shepard, E. G. Connette, D. Page, Charles C. Crook, N. L. Bates and S. M. Coon. The directors organized as follows: S. M. Coon, president; D. A. Williams, secretary; James P. Doyle, treasurer.

ELMIRA, N. Y.—The Elmira-Corning Short Line has purchased the Corning & Painted Post Street Railway Company. It seems that the Railroad Commissioners refused the application of the Elmira-Corning Short Line to build because of the opposition of the Erie and the Lackawanna Railroads. By the purchase of the Corning Company the Elmira Company will build its contemplated line as an extension of the former, the Railroad Commissioners not having jurisdiction over a line already in operation.

BELLAIRE, OHIO.—The Belmont Electric Street Railway Company has a franchise ordinance pending in the City Council, and expects to build a local line.

CELINA, OHIO.—The Geneva Traction Company, of Geneva, Ind., has applied for a franchise to operate a street railway in this city. The matter is before the Council.

CONNEAUT, OHIO.—The Pennsylvania & Ohio Railway Company is considering building a line to the lake front and along the lake road north of here to accommodate the numerous summer residents.

BUCYRUS, OHIO.—The Marion-Bucyrus Railway & Light Company has been chartered, with $250,000 capital stock, by Ellis Bartholomew, G. K. Canfield, Charles B. Selby, G. A. Bartholomew and P. M. Ditto.

COLUMBUS, OHIO.—The Columbus, Newark & Zanesville Traction Company has installed a new generating unit in its power station at Hebron. This gives the company ample capacity to handle its 84 miles of lines.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway Company is building a line up the Muskingum Valley. It will be completed as far as Pinchtown in thirty days, and next spring it will be extended to the village of Lowell by way of Devol.

EAST LIVERPOOL, OHIO.—The Jefferson County Commissioners have asked the East Liverpool Street Railway Company for a proposition for extending its line from Wellsville to Empire. The commissioners offer a fifty-year franchise under certain conditions.

CANTON, OHIO.—The Canton & Youngstown Railway Company has been incorporated, with $50,000 capital stock. The promoters are William H. Clark, W. L. Davis, J. J. Whitacre, John E. Monnot and L. D. Blanchard, all well-known citizens of Canton. The Osborne Engineering Company, of Cleveland, is making the preliminary surveys for the line, which will be built wholly on private right of way.

CLEVELAND, OHIO.—The Lake Shore Electric Railway has completed important improvements in its power distribution which will effect great savings in the cost of operation, this being made possible by the installation of a large alternating-current unit at its Beach Park power station. The old direct-current plants at Sandusky and Milan have been abandoned and rotary converter sub-stations have been installed in the buildings, so that the entire system, including the Sandusky city lines, is now handled from the Fremont and Beach Park stations with alternating-current transmissions, each station handling about 80 miles of road.

SELINSGROVE, PA.—Selinsgrove and Sunbury will be joined by an electric railway to be owned by a corporation known as the Sunbury & Selinsgrove Electric Railway Company. Harrisburg capitalists are backing the project.

LANCASTER, PA.—J. R. Raymond, of Middletown, has just finished the survey for a section of the electric railway which is to connect Philadelphia and Harrisburg, via Lancaster. This section will be from Middletown to Mount Joy.

PHILADELPHIA, PA.—It is stated that a petition for a foreclosure sale of the Philadelphia & Lehigh Valley Traction Company is backed by 88 per cent. of the number of bondholders, representing $1,100,000 in bonds. This is less than a majority of the bonds.

HARRISBURG, PA.—A charter has been granted at the State Department to the Tarentum & Brockenbridge Street Railway Company, capital $50,000, to build 2½ miles of line from Tarentum to Camp Meeting Road via Brockenridge, Allegheny County. William White, Jr., of Pittsburg, is treasurer of the company.

MIDDLETOWN, PA.—Two electric railway ordinances are now before the Council, one granting a franchise to the Philadelphia, Lancaster & Harrisburg Street Railway Company and the other granting a franchise to the Elizabethtown & Middletown Street Railway Company. Edgar Tennis has appeared before the Council in the interest of the first-named company.

SUNBURY, PA.—The Danville & Northumberland Street Railway Company has been chartered at Harrisburg with a capitalization of $60,000, to build a 10-mile road, which will connect with the Sunbury & Northumberland line at Northumberland and with the Danville & Bloomsburg line at Danville. The incorporators are F. C. Angle, of Danville, president; W. F. Pascoe, L. P. Bane, C. M. Howell, J. H. Danner and M. C. Pascoe.

ALLENTOWN, PA.—Street railway companies have been incorporated as follows at Allentown: Newtown & Hatboro Street Railway Company, capital stock $75,000. President, Charles M. Bates, Allentown. Directors. John G. Honecker, Yardley; Martin V. Dager, New Hope; Horace S. Reeder, Newtown; C. M. Walter, V. D. Bates, Allentown. Willow Grove & Richboro Street Railway Company, capital stock $50,000; president, Charles M. Bates, Allentown. Directors: John G. Honecker, Yardley; Martin V. Dager, New Hope; Horace S. Reeder, Newtown; C. M. Walter, V. D. Bates, Allentown.

CHATTANOOGA, TENN.—It is said that S. W. Divine and associates will soon apply for a charter of incorporation for the proposed electric railway to connect Chattanooga, Cleveland and Ducktown. It is understood that the company will be incorporated as the Tennessee-Alabama Interurban Railway. Franchises from both the county and city have been granted and considerable right of way has been purchased. The proposed line will extend from the central part of this city through the Fifth district to Missionary Ridge, where the ridge will be tunnelled, and the road will then be built to Ducktown via Cleveland. It is understood that a line will also be built into Alabama.

NEW BRAUNFELS, TEX.—M. M. Brice, of Chicago, Ill., and George A. Hill, of Beaumont, Tex., have been investigating the situation at New Braunfels with the object of building an electric railway from this place to Seguin.

HAMPTON, VA.—The Corporation Commission has granted a charter to the Hampton & Yorktown Railway Company, Hampton. Capital stock, $100,000 to $500,000; F. W. Dailing, president.

MANITOWOC, WIS.—The Fond du Lac & Northeastern Electric Railway Company has filed a notice of its acceptance of the franchise passed by the City Council here June 20.

OSHKOSH, WIS.—Incorporation papers have been filed with the Secretary of State for the Oshkosh & Western Electric Railway Company, which will build an electric railway from Omro to Berlin, a distance of 22 miles, and run cars from Oshkosh to Berlin. The articles of incorporation are signed by J. H. Porter, a capitalist of Oshkosh; Clement C. Smith, of the Columbia Construction Company, of Milwaukee; Attorney George Milton, of Oshkosh, and C. S. Morris, of Berlin.

VANCOUVER, B. C.—It is reported that plans are being considered for operating a line of electric railway between Cloverdale and Port Guichon by the Victoria & Terminal Railway & Ferry Company.

BEAURIVAGE, QUE.—The corporation of the village of Beaurivage, of Longue Point, has granted the Suburban Tramway & Power Company a franchise to construct an electric railway here.

THE AUTOMOBILE.

NEW CASTLE, IND.—The first mail to be delivered regularly in an automobile on a rural route in this part of the State was delivered Sept. 14. The route of 24 miles was covered in two hours. Delivery by horses required eight hours.

ANDERSON, IND.—Twenty-seven farmers in Madison County have formed themselves into an association and filed articles of incorporation and received commissions from the county auditor. The object of the corporation is to prevent lawlessness, but ostensibly to arrest all automobilists who do not give room on the road, and who do not respect speed regulations.

NEW INDUSTRIAL COMPANIES.

THE ELECTRICAL CONSTRUCTION COMPANY has been formed by E. L. Andrews, C. P. Lofthouse, H. L. Worthington and others; capital, $100,000. Place of business, San Francisco.

THE HAYNE MOTOR COMPANY has been incorporated at Plainfield, N. J., with a capital stock of $25,000. The incorporators are Harrison Coddington, Chas. F. Fulmer, Chas. F. Hyne and William B. Harsel.

THE OLIVER ELECTRIC COMPANY has been formed, with offices in Jersey City, to manufacture and deal in electric machinery and appliances, capital stock $1,000,000.

THE FAIRCHILD & OLNEY MACHINE COMPANY, of Olney, Ill., has been chartered at Dover, Del. Its purpose is to construct and operate by electricity or other motive power railways and rapid transit lines; capital, $300,000.

THE WILLIAMS ELECTRIC MACHINE COMPANY, Akron, Ohio, has been incorporated with a capital stock of $100,000. The incorporators are Harry A. Williams, J. F. Townsend, W. S. Mathias, Tolma R. Smith and J. W. Welsh.

THE HOLMES ELECTRIC PROTECTIVE COMPANY, New York, with an authorized capital stock of $100,000 has been incorporated for the purpose of conducting a general electrical and telephone business. The incorporators are Edward T. Holmes and Robert A. C. Smith, of New York; Henry B. Wilcox, H. K. McCabe and Charles T. Crane.

THE UNION ELECTRIC MANUFACTURING COMPANY, of South Bend, has filed articles of incorporation with the secretary of State. The capital stock is $5,000.. The company will engage in the manufacture of electrical supplies and specialties for use in the transmission of electrical current and in the manufacture and sale of electrical machinery. James Holstrom, Jas. MacGregor, Chas. T. Wade and E. B. Jackson, are the incorporators.

LEGAL.

A POST OFFICE "FRAUD ORDER."—An order has been issued by the Post Office Department denying the use of the mails to the Thomas A. Edison, Jr., Chemical Company, of Stone Street, New York, on the ground that the concern is attempting a fraud on the public. The Edison involved is the son of the inventor, who has been subjected to great annoyance by the affair. The concern has been under investigation for several weeks, and the reports of inspectors show that it makes and sells a "magno-electric vitalizer" which the advertising literature of the concern claims has remarkable tonic, reconstructive, and bactericidal powers. In the papers is a copy of an affidavit by Thomas A. Edison, Sr., saying that "his said son has never shown any ability as an inventor or electrical expert, and that deponent believes his said son is incapable of making any new invention or discovery of merit." The circulars sent out by the company laud Edison, the younger, as a celebrated inventor and describe his discovery as one of the remarkable events of the age, a panacea for the human race which will banish disease. One of the circulars said that the Japanese Government was trying to get a supply of the vitalizers for the Japanese troops in the field. It was also affirmed that Mr. Edison himself personally gave his time and great abilities to each patient and patron of the concern. Accompanying the papers is a statement from young Mr. Edison saying he did not work out the vitalizer, but that others designed it and he merely signed the application for the patent that was sought by the promoters of the scheme. He denies that he gave any attention to the business of the concern, but admits that he drew a salary of $35 a week from it. The company has been selling the vitalizers at the price of $8 each.

PERSONAL.

MR. J. M. ANDERSON, treasurer of the Albert & J. M. Anderson Mfg. Company, of Boston, Mass., was a visitor to New York for a few days last week.

MR. L. B. STILLWELL, electrical director of the Interborough Rapid Transit system, has gone to St. Louis to inspect the transportation exhibits, but expects to return to New York next week, and will be on hand for the formal opening of the subway to the public.

MR. J. K. ROBINSON, of Iquique, Chili, who represents the Westinghouse and other prominent United States manufacturing interests on the West Coast of South America, is now on a visit to the United States. He is making his headquarters at the offices, 116 Broad Street, of the export commission firm of William E. Peck & Company.

MR. FRANK HEDLEY.—At a meeting of the directors of the Interborough Rapid Transit Company, Vice-President E. P. Bryan was relieved of the duties of general manager, the office of general superintendent held by Frank Hedley was abolished, and Mr. Hedley was made general manager. He will report to Vice-President Bryan.

MR. JAMES F. CUMMINGS, of London, who has the contract for the supplying and laying of the conduit for the St. Petersburg municipal telephone and telegraph systems, is now on a visit to this side. The conduit is being shipped from the Raritan River plants of the National Fireproofing Company. Mr. Cummings expects to secure another large Russian contract. He is at the Hotel Imperial.

MR. C. B. ROULET, so well and favorably known in the electrical trade through his connection with the Osburn Flexible Conduit Company, manufacturers of "Flexduct," with whom he has been travelling representative, has resigned his position to accept the post of chief electrical inspector of the Texas Board of Fire Prevention, with headquarters in Dallas, Tex. Mr. Roulet's many friends wish him every success in his new office.

SIR W. RAMSAY.—Columbia University, New York City, has conferred the honorary degree of Doctor of Science upon Sir William Ramsay, of London, recently president of the Society of Chemical Industry, and William H. Nicholls, of this city, the present president. The first award of the Barnard Medal of Columbia was made to Prof. Ramsay and at the same time to Lord Rayleigh in recognition of their discovery and investigations of the new element argon.

MESSRS. W. COOK, manager of the railway department, and S. Nicholson, manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company, have returned East from San Francisco via Salt Lake City, after making a tour of the Pacific Coast. They inspected the De Sabla electric power transmission plant of the California Gas & Electric Corporation at Nimshaw, Cal., in company with W. S. Heger, Westinghouse manager in San Francisco.

MR. H. L. RISELEY, engineer of the Newcastle-on-Tyne Electricity Supply Company, Limited, one of the largest concerns of its description in Europe, is now here. This British company furnishes power to operate several of the big shipbuilding and other industrial plants on the Tyne and also generates energy for the new electric railway section of the North Eastern Railway which is equipped with both Thomson-Houston and Westinghouse apparatus. The Newcastle-on-Tyne equipment includes four 5000-kw Parsons turbines. Mr. Riseley has gone to St. Louis.

MR. R. D. MERSHON.—Some time ago, Mr. J. E. Aldred, of Boston, Mr. James Ross, of Montreal, and Mr. Frederic Nicholls, of Toronto, contributed jointly a sum of money to enable Mr. Ralph D. Mershon to take up certain high voltage experimnetal work, the results of which are to be made public in a paper by him. The preparations for this work, which will be done at Niagara Falls, on the New York side, are about completed and the work itself will soon be under way. It is proposed to take measurements on an experimental line up to at least 100,000 volts and possibly as high as 200,000 volts.

MR. C. G. Y. KING, who has for some twelve years been prominently connected with electrical interests in Chicago and with the engineering department of the Chicago Edison Company, has made a decided change of base. He has taken the general management of three allied companies—the Southern Fire Brick & Clay Company, the Warwick Construction Company, and the Steinl Chimney Construction Company of Chicago. Mr. King will be missed from his old field, having been associated with President Insull as far back as 1882, and a host of friends will wish him abundant success in his new venture.

MR. A. W. McLIMONT, an old Thomson-Houston man, who has constructed a number of lighting and power systems in Central and South America, has been appointed to act in the capacity of consulting expert to the South American merchant house of W. R. Grace & Company, which represents the interests of the General Electric Company in Chili, Peru and Bolivia. Mr. McLimont returned recently from Peru, where he superintended the building of the Lima-Chorillos electric traction system—the first to be constructed in that part of the world. He will make his headquarters at the New York offices of the Grace concern, 1 Hanover Square.

MR. HENRY DEANE, engineer-in-chief of the railways and tramways department of the New South Wales Government, has sailed for home after a somewhat extended visit to this side. While here he gathered considerable data which he will embody in a report to the Public Works Department, and it is understood that in the near future some substantial contracts will be placed on tis side. Mr. Deane's department is totally distinct from that of the Railroad and Tramway Commissioners, as they have more to do with the operation of the systems, while he is a construction man. The Sydney electric traction system is to be largely extended and Mr. Deane will have direct supervision during construction.

MR. ROBERT KAYE GRAY, president of the Institution of Electrical Engineers, sailed for England on the White Star steamer "Baltic," on October 5, thus closing officially, so to speak, the tour of his society in this country. On the evening of October 4, Mr. Gray was the guest at a little farewell dinner at the Engineers' Club, among those present being Messrs. J. W. Lieb, Jr., Frank J. Sprague, Bion J. Arnold, T. C. Martin, J. M. Wakeman and A. Pirelli. On behalf of the New York local reception committee of the Institute, a framed autograph portrait of Mr. Edison, with inscription plate, was given to Mr. Gray personally as a souvenir of the final function of the British tour, namely, the visit to the Edison Laboratory on September 22. It is understood that the Institute as a body is preparing to place on record in an appropriate manner its appreciation of the opportunity given it to entertain the sister society and its warm esteem of Mr. Gray himself.

ALLIS-CHALMERS PERSONNEL.—Mr. Chas. S. Buell, mechanical engineer, has entered the employ of the Allis-Chalmers Company as salesman and engineer in its power department. Mr. John F. Burke has joined the selling force of the Allis-Chalmers Company with headquarters in Omaha, Neb., and will engage in the sale of Corliss engines, electrical apparatus, and crushing and cement machinery for the latter concern. Mr. Wilbur M. Ruth, an engineer of wide experience in both steam and electrical work and until recently assistant to the president of the Mesta Machine Company, Pittsburg,

Pa., and previously employed on the engineering staff of the E. P. Allis Company, has accepted a position as salesman and engineer for the Allis-Chalmers Company at its Pittsburg office. Mr. M. C. Miller, one of the leading men in the alternating current department of the Westinghouse Electric & Mfg. Company, Pittsburg, Pa., has resigned his position with that company to accept a similar position with the Allis-Chalmers Company in its electrical department. Mr. Chas. F. Adae, lately manager of the Pittsburg office of the C. Lee Cook Company, has been appointed to the selling force of the Allis-Chalmers Company, at its New York office. Mr. S. H. Sharpsteen, for a number of years with the General Electric Company as salesman in its New York office, has accepted a similar position with the Allis-Chalmers Company in its New York Office. Mr. G. Fred Collins, who has a very extensive acquaintance throughout the East among officials and engineers of large railroad and steel companies, has recently entered the employ of the Allis-Chalmers Company as special representative at its New York Office. Mr. W. M. S. Miller, who was in the employ of the Westinghouse Electric & Mfg. Company in the manufacturing production and detail correspondence departments, and until lately in the detail and supply department, covering in all a period of some fourteen years, has joined the staff of the Allis-Chalmers Company with headquarters in Chicago. Mr. R. L. Richardson has become a member of the Pittsburg selling force of the Allis-Chalmers Company. Mr. John V. Redfield has been appointed to the sales staff of the Allis-Chalmers-Bullock interests at the Chicago office. Mr. James Ashworth, until recently engineer of the City of Chicago in the Department of Water Supply, has entered the employ of the Allis-Chalmers Company as salesman in its pumping engine department. Mr. Otto Clyde Ross, lately in the employ of the Hartford Lead, Zinc, Mining & Smelting Company as engineer, has accepted an appointment with the Allis-Chalmers Company as engineer and salesman. Messrs. Buell, Burke and Redfield were in the Westinghouse service until recently.

OBITUARY.

HENRY C. PAYNE.

MR. HENRY C. PAYNE.—It is with deep regret that we record the death of Mr. Henry C. Payne, Postmaster-General of the United States, at Washington, on October 4. The cause of death was disease of the mitral valve and dilation of the heart. For some years past Mr. Payne had been ailing, and latterly he had been seriously ill. President Roosevelt had made a call only ten minutes before Mr. Payne died; and it was not expected that he would succumb so soon to the attack of the disease, having indeed rallied a few hours before. Henry C. Payne was born in Ashfield, Franklin County, Mass., Nov. 23, 1843. He received his education in the common schools and in an academy. He moved to Wisconsin when twenty years old and resided there the remainder of his life. He was particularly identified with Bell telephone interests, as well as with electric lighting and electric railway work. He served as president of the Wisconsin Telephone Company, as director in the First National Bank of Milwaukee, president of the Milwaukee & Northern Railroad Company, vice-president of the Milwaukee & Cream City Street Railway Companies, and general manager of their combined properties. He also was at one time, 1893, president of the American Street Railway Association, and was receiver for the Northern Pacific Railroad. He was likewise extensively engaged in real estate transactions. President Grant, in 1876, appointed him postmaster of Milwaukee, and he held that position for ten years under successive appointments of Presidents Hayes and Arthur. He had long been a prominent figure at National Conventions, having been a delegate to the conventions of 1880, 1888 and 1892. He was acting chairman of the National Committee after Senator Hanna's death and called the Chicago Convention to order. In January, 1902, President Roosevelt appointed him Postmaster General, and he had held that office up to the present time. Mr. Payne leaves a widow, but no children.

MR. P. B. CORNWALL, president of the Mutual Electric Light Company of San Francisco, died at his home in that city on Sept. 25 last, at the age of 82 years. Mr. Cornwall was one of the California pioneers in 1848, and, notwithstanding his advanced age, he gave active attention to his business affairs until within 10 days of his death. He was very progressive in his ideas and was one of the first to engage in electric lighting on the coast. Deceased was highly esteemed by all who knew him.

MR. B. E. GREENE.—Mr. Burton E. Greene died in the Seney Hospital, Brooklyn, last week, of heart failure resulting from an operation for the removal of cancer. He was born in McGrawville, N. Y., in 1862, his father being a descendant of Dr. John Greene, who was associated with Roger Williams in the founding of the colony of Rhode Island. He worked on the Chicago *Times*. the Buffalo *Courier*, the New York *Tribune*, the *Evening Post* and the *Journal of Commerce*. He was associated for some time with Mrs. Martha J. Lamb in conducting the *Magazine of American History*. In 1892 he became business manager of *Electricity*, and later was one of its editors. He retired in 1896. He is survived by a widow and three daughters.

MR. C. M. DALLY.—Mr. Clarence M. Dally, electrical engineer, died on Oct. 3 at his home, 103 Clinton St. North, East Orange, a martyr to science, the beginning of his illness having been due to his experimental work in connection with the Roentgen rays with Mr. Edison. For seven years he patiently bore terrible suffering and underwent seven operations, which finally culminated in the amputation of both his arms. Mr. Dally was born in Woodbridge, N. J., thirty-nine years ago and served five years in the United States Navy as chief gunner on the Enterprise, but had been connected with Mr. Edison for the past sixteen years. He is survived by his wife and two sons. Mr. Dally conducted the first public exhibition of the Roentgen ray on a large scale in this country, namely, that at the Electrical Exhibition in the Grand Central Palace, New York, for Mr. Edison, under the auspices of the National Electric Light Association.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago and San Francisco, reports that its Zenith type of lamp has passed the novelty stage and is now a full-fledged lamp of commerce. A lamp of this description was a long time coming and now that it has come the demand for it is great. It is so adequately "the thing" that its usefulness is beyond question.

STURGESS GOVERNOR ENGINEERING COMPANY, of Watervliet, N. Y., is building an addition to its works which will give an increase of 50 per cent. in floor area. It has been crowded for some time and rushed with orders. This extension will enable it to cope successfully with the work in hand and in view. It is installing an overhead traveling crane to improve also its facilities for handling work.

AUTOMATIC TELEPHONY.—The Automatic Electric Company, of Chicago, has just issued some interesting additions to its literature in regard to the merits of automatic telephony. Two of these pamphlets are devoted to Portland, Me., and Grand Rapids, Mich., respectively. In both of these cities the system is in use, and from each a large mass of testimony is brought forward as to the way the thing works in actual practice. There are pictures also of the two exchanges. Another "talking point" is found in the copy of the last annual report of the Grand Rapids Company for the year ended June 30, 1904.

SAWYER-MAN LAMPS.—The Sawyer-Man Electric Company reports a very marked increase in the orders it is receiving, both in number and in volume of material required. So far this year the number of lamps it actually sold has greatly exceeded the number sold for the corresponding period of any preceding year, while the busy lamp season just opening promises to be phenomenal. This is largely due to the fact that ample stocks are being carried in all of the principal cities, from which also sales are being conducted by the extensive organization of the Westinghouse Electric & Mfg. Company. In addition to this the Sawyer-Man Company—pioneer in lamp manufacture—has never ceased its efforts to produce what shall be recognized as the highest type of the art.

NEW YORK EXHIBITION.—An exhibition which will interest every business man in the country will open in Madison Square Garden on December 12 and continue for six days. During that time there will be contests of speed between expert stenographers, and operators of different makes of typewriters will enter into endurance and speed competition for prizes of great value. The exhibition will be the first of the kind ever given in the world, and will include every device for labor-saving in large offices. The floor space for showing goods and for the speed contests has nearly all been taken, and it is more than likely Madison Square Garden will be crowded with persons interested in mercantile affairs, their object being to see if there is not some new article on the market that will save time as well as labor.

THE NATIONAL ELECTRIC COMPANY, of Milwaukee, and the Hooven, Owens, Rentschler Company, of Hamilton, Ohio, offer an opportunity to purchase their exhibit at Block 46, Machinery Building, Louisiana Purchase Exposition. This unit consists of a National revolving field alternator of 1500-kw capacity, direct-connected to the new Hamilton Corliss vertical, cross compound, condensing engine, running at 83 r.p.m. The entire equipment represents the latest development of engineering design, and may be seen in operation until the close of the exposition. A detailed description, with illustrations, will be mailed upon request, and the representatives of the above firms may be found at Block 46, Machinery Building. The National Electric Company may also be interviewed at Section 6, Electricity Building, where a number of other direct and alternating units of smaller capacities are to be disposed of.

THE OTTO GAS ENGINE WORKS, Philadelphia, have recently ordered a large oil filter from the Burt Manufacturing Company, of Akron, Ohio. This makes three of the Burt Manufacturing Company's filters which this concern is now using in its testing-room. The Otto Gas Engine Works say that they had considerable difficulty in filtering their oil until they had installed this filter and they speak in very flattering terms of the work which this filter does. In the American oil filter, the Burt Manufacturing Company has, it is claimed, the only filter which will successfully handle the heavy grades of oil used in connection with gas and gasoline engines. This is due to the hot water chamber at the top which heats the oil by means of the hot water exhaust from the engines, thus thinning it and facilitating the filtering of the same. A large oil filter made by the Burt Manufacturing Company has also been sent recently to the Connersville Blower Company at Connersville, Ind.

UNIVERSAL GUY CLAMP.—Mr. Frank B. Cook has brought out recently Cook's "Universal" guy clamp, a most radical departure from the accepted types of guy clamps. It not only takes any size strand from 3-16 to ½ inch, but when it once takes them it holds them. One of Mr. Cook's circulars is a reproduction of the Armour Institute's record of some comparative tests which they made of several well known types of clamps and the figures are startling. Telephone, telegraph, light and power companies have evidenced their appreciation by sending in some big orders. The Home Telephone Company, of Los Angeles, recently placed an order for 5000, the American Steel & Wire Company, 3000, the New Long Distance Telephone Company, of Indianapolis, 500, the Buffum Telephone Company, Louisiana, Mo., 300, Sheboygan Telephone Company, Sheboygan, Mich., 500, Indianapolis Light & Power Co., 8000. Empire Electric Co., San Diego, Cal., 5000. A canvass of the supply houses

shows that practically all of them are handling Cook's "Universal." It appears to be a "good thing," and it likewise appears that Mr. Cook is "pushing it along."

FRINK REFLECTORS.—While local conditions may compel a merchant to improve his store, he is naturally attracted by those fittings and devices which have a widespread national reputation. In no other line perhaps is the decision so nearly unanimous as in regard to lighting of show windows, floor cases, etc. The Frink system of patent reflectors has been installed in the leading stores everywhere and as it embodies the only perfect method of store lighting, has met with phenomenal success. Some of the more recent stores adopting Frink's special patent window reflectors are the following: J. M. Giddings, Duluth, Minn.; Mentor, Rosenbloom & Co., Dayton, Ohio; Phillipsborn's, Baltimore; Siegel's, Detroit; Weiler Bros., Portland, Ind.; Ryan & Remick, Passaic, N. J.; Weille & Son, Paducah, Ky.; A. Cassanova, New Orleans; L. Solomon & Son, Cairo, Ill.; The Fair, Havre, Mont.; A. W. Jones & Co., Salem, Ohio; Springer & Rose, Port Huron, Mich. All of these and many other firms using Frink reflectors have much more attractive windows this season than ever before. Contractors and engineers who are interested may obtain full information, prices, etc., by addressing I. P. Frink, 551 Pearl Street, New York, the patentee and sole manufacturer.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPTEMBER 27, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

770,737. THIRD RAIL FOR ELECTRIC RAILWAYS; Albert F. Chase, Haddonfield, N. J. App. filed March 17, 1904. The rail is inverted and provided with superposed flanges or wings which act as a shield to protect the contact from the weather.

770,744. TROLLEY; Samuel Fisher and Albert Sanders, Butler, Pa. App. filed June 27, 1903. A pair of guard wheels are mounted on pivoted arms above the trolley wheel to retain the wire in the groove of the wheel; they can be opened by pulling on a cord attached to the levers.

770,769. BLOCK SIGNALING SYSTEM FOR RAILWAYS; Chester T. Morey, Cambridge, Mass. App. filed May 12, 1904. A novel system of wiring and means for controlling the circuit whereby a car moving in one direction closes a circuit and causes the mechanism for closing to be retained in locked position where it is held until the car reaches the other end of the block.

770,796. APPARATUS FOR SEPARATING ORE; Henry F. Campbell, Boston, Mass. App. filed May 16, 1901. A special arrangement of the pole pieces of a magnet with respect to the conveyor along with which the pulverized ore is carried.

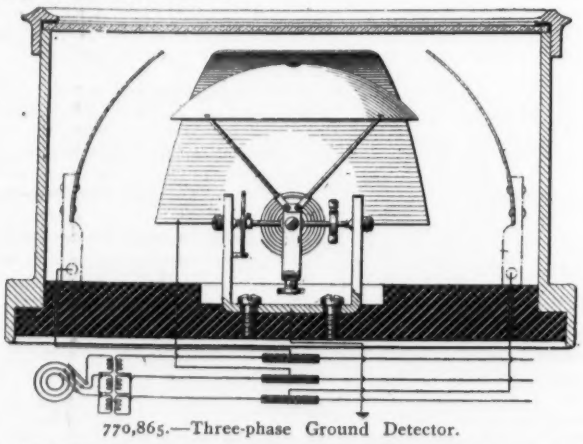
770,818. LOCKING DEVICE FOR SWITCHES; Max P. J. Nemmert, Wilkinsburg, Pa. App. filed Nov. 21, 1903. A locking device to prevent a double-throw switch from falling from the open position into contact with the lower clips.

770,865. THREE-PHASE GROUND DETECTOR; Paul MacGahan, Pittsburg, Pa. App. filed Jan. 20, 1904. Comprises three stationary vanes, a movable vane located in inductive relation thereto and means for mounting the movable vane which permits of its movement toward or from any of the stationary vanes.

770,873. CONTROLLING DEVICE FOR ELECTRICAL LIFTS OR HOISTING MECHANISMS; Hugo Stahl, Stuttgart, Germany. App. filed July 11, 1903. An auxiliary motor with braking device for the purpose of slowly switching on the current and an apparatus combined with the hoisting mechanism for automatically switching off the current and stopping the car.

770,886. CONTROLLER APPARATUS; Patrick S. Barrett, Scranton, Pa. App. filed Feb. 4, 1904. Means for arresting the controller lever at each step of its rotary movement in order to prevent too rapid change of the circuits.

770,911. THIRD RAIL SYSTEM; Leslie M. La Barr, Forest City, Pa. App. filed June 22, 1904. Details.



770,865.—Three-phase Ground Detector.

770,922. MOTOR; Edwin S. Pillsbury and Edward Bretch, St. Louis, Mo. App. filed April 17, 1903. A structure having two motors adapted to act upon the same movable part and means whereby power can be first applied to one of them and after the load is started, it can be cut off from the first motor and supplied to the second.

770,923. ELECTRIC MOTOR; Edwin S. Pillsbury, St. Louis, Mo. App. filed Dec. 17, 1903. The object is to construct an induction motor so that at starting instead of the secondary current induced in the armature being commutated, the current supplied to the field is commutated, making it possible to employ larger conductors in the armature, rendering the same more substantial and of low resistance to carry a greater load than an armature provided with the usual fine wire windings.

770,951. RELAY; John C. Barclay, New York, N. Y. App. filed Jan. 23, 1904. Means whereby a slight movement of the armature brings into action a secondary circuit wound upon the magnet core, the effect of which is to increase the power available for the movement of the armature.

770,960. THIRD RAIL INSULATOR; Robert V. Dunbar, New York, N. Y. App. filed Nov. 6, 1903. An insulating block having a removable base rigidly engaging the same, but readily detachable from either side thereof so as to be removable without disturbing the rail.

770,962. INSULATOR; Jacob F. Gill, Northeast, Pa. App. filed June 2, 1904. The wire passing into a vertical slot in the top of the insulator is held by a peg screwing axially into the top of the insulator.

770,991. INCANDESCENT ELECTRIC MATERIAL; August Voelker, Berlin, Germany. App. filed June 2, 1904.

770,999. WIRE-SUPPORT; Charles Frederick Bettman and John Zapp, New Albany, Ind. App. filed July 3, 1903.

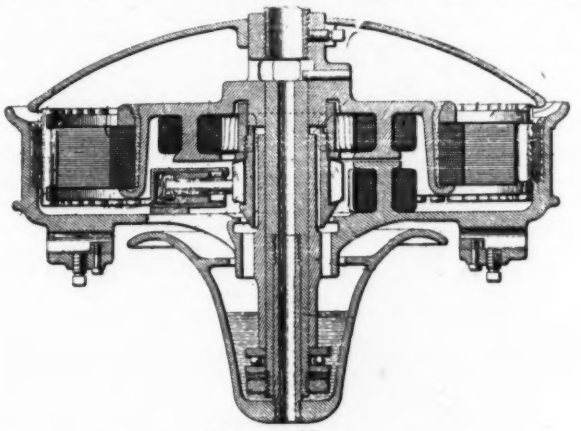
771,014. SAFETY SWITCH; George H. Hill, Montreal, Canada. App. filed Sept. 27, 1902. Details.

771,025. MANUFACTURE OF ZINC-WHITE; Jacques Oettli, Lausanne, Switzerland. App. filed July 6, 1903.

771,027. SIGNALING SYSTEM FOR ELECTRICALLY OPERATED RAILWAYS; Lewis B. Stillwell, Lakewood, N. J., and Henry Latey, New York, N. Y. App. filed May 18, 1904. Signal boxes are located at various sections along the line and contain push buttons or similar devices which when actuated will notify the attendant at sub-stations to cut off the power from a corresponding section of the road.

771,029. CROSSING SIGNAL FOR RAILWAYS; Eugene W. Vogel, Chicago, Ill. App. filed May 20, 1901. Details of a railway crossing signal wherein the train on reaching the crossing stops the signal and finally resets it for another train.

771,030. RAILROAD SIGNAL CIRCUITS; Eugene W. Vogel, Chicago, Ill. App. filed Sept. 20, 1901. By means of a single wire circuit the signals



770,922.—Motor.

at a number of crossings can be successively started and stopped as the train passes.

771,086. X-RAY TUBE; Carl H. F. Muller, Hamburg, Germany. App. filed March 15, 1901. A secondary cathode mounted in the vacuous space carries a gas-evolving substance responsive to heat-changes.

771,114. SWITCHING MECHANISM FOR INTERCOMMUNICATING TELEPHONE LINES; Albert K. Andriano and Hermann Herbstritt, San Francisco, Cal. App. filed Jan. 14, 1901.

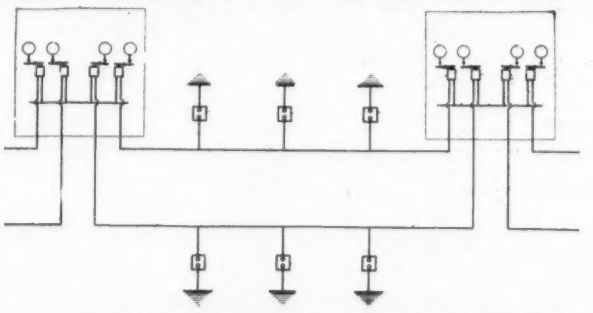
771,128. HYGIENIC APPLIANCE FOR MOUTHPIECES; Horace L. Cutter, Los Angeles, Cal. App. filed Aug. 15, 1902.

771,135. MICROPHONE; Ernest B. Fahnestock, New York, N. Y. App. filed Oct. 25, 1902.

771,142. ANNUNCIATOR; Thomas W. Gleeson, Boston, Mass. App. filed July 20, 1900. Details.

771,144. THERMOSTAT; John D. Gould, New York, N. Y. App. filed May 19, 1903. A thermostatic cable having a fusible member, has its end sealed into an insulating block to prevent movement of the fusible member along the cable under the influence of heat.

771,188. POLE CHANGER; William I. Thomson, Newark, N. J. App. filed Jan. 2, 1903. A mechanical device for throwing a switch whereby adequate power can always be applied to remove the blades from the clips.



771,027.—Signaling System for Electrically Operated Railways.

771,193. ELECTROMAGNETIC TRACTION DEVICE AND EMERGENCY BRAKE; Charles A. Wells, Chicago, Ill. App. filed May 11, 1903. A magnet core is pivoted at one end upon a wheel axle and at the other end carries a shoe which may be held slightly above the rail so that when energized the attraction of the shoe for the rail will add to the pressure of the wheel upon the rail, or the shoe may be allowed to rest upon the rail and furnish an emergency brake.

771,206. TROLLEY WHEEL CONTROLLER; Benjamin F. Jackson, Boston, Mass. App. filed Aug. 15, 1902. Details.

771,207. APPARATUS FOR REGISTERING THE SUPPLY OF ELECTRICITY; Gisbert Kapp, Berlin, Germany. App. filed Nov. 19, 1897. (See Current News and Notes.)

770,792. MEANS FOR TELEGRAPHING; John Beard, Livingston, Mont. App. filed April 27, 1904. (See Current News and Notes.)

100 SUBSCRIBERS of the Citizens' Telephone Company of Grand Rapids, Michigan, were selected at random by a disinterested party and asked how they liked that company's Automatic Telephone Service in comparison with the manual service which it replaced.

95 OF THEM said it was so perfect that there could be no comparison, they greatly preferred it.

4 OF THEM said they "didn't care which they had."

1 OF THEM preferred the manual service.

The above percentages indicate the attitude of 6,000 subscribers to Automatic Telephone service in Grand Rapids.

MR. TELEPHONE MANAGER, if you are trying to satisfy the public and give your patrons the sort of service they appreciate most you will take the hint that this conveys and give them Automatic Service.

AUTOMATIC ELECTRIC COMPANY

Van Buren and Morgan Streets **CHICAGO, U.S.A.**

MONOPLEX TELEPHONES $2.50 EACH

Also a Trade Discount,

Monoplex Telephones are the simplest and most reliable instruments now on the market. Thousands are in use, giving perfect service. They are guaranteed for one year.

Intercommunicating Instruments $4.00 per station
Desk Instruments, 6.00 " "
2 end Instruments, 2.50 per end.

Atwater Kent Mfg. Co., 120 N. 6th St., Philadelphia

TELEPHONES Central energy generator call
Multiple Trunking **SWITCHBOARDS**
FOR ANY SIZE EXCHANGE
All we ask is your request for a
SAMPLE AND QUOTATION
INTERNATIONAL TEL. MFG. CO.
Harrison and Clinton, Chicago, U. S. A.

Couch TELEPHONES
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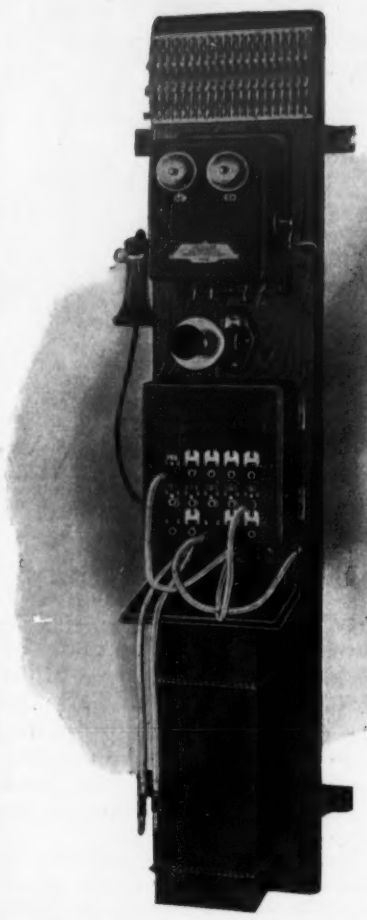

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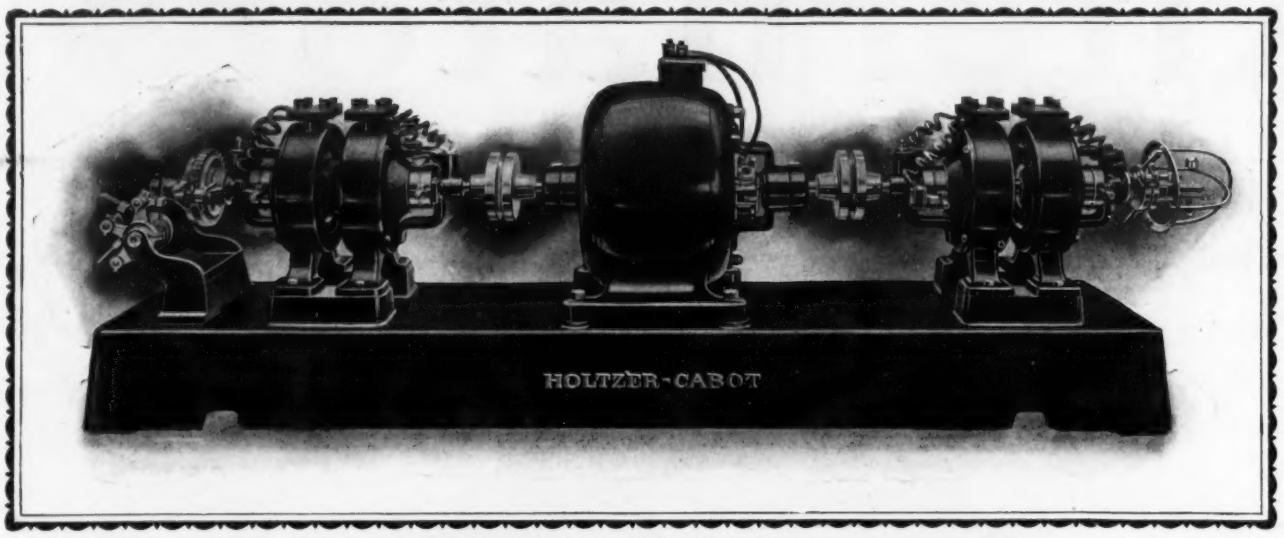

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